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1047.771



PATENT SPECIFICATION

NO DRAWINGS

1047.771

Date of Application and Complete Specification April 22, 1963.

No. 15789/63.

Two Applications made in United States of America (Nos. 189,717 and 189,718) on April 24 1962.

Complete Specification Published: Nov. 9, 1966.

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Index at acceptance:—C5 D(6A5B, 6A5C, 6A5D1, 6A5D2, 6A5E, 6B1, 6B2, 6B10A, 6B11A, 6B11C, 6B12A, 6B12B1, 6B12B3, 6B12C6, 6B12C8, 6B12C9, 6B12E, 6B12F1, 6B12F2, 6B12G2A, 6B12G2B, 6B12G3, 6B12G4, 6B12K2, 6B12L, 6B12M, 6B12N3, 6B12N4)

Int. Cl.:—C 11 d 1/12, C 11 d 5/00

COMPLETE SPECIFICATION

Improvements in or relating to Synthetic Detergent Compositions

We, STEPAN CHEMICAL COMPANY, of Edens and Winnetka Road, Northfield, Illinois, United States of America, a Corporation of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to novel heavy-duty synthetic detergents and detergent compositions, and more particularly, to improved compositions of the type characterized by the presence therein of water-soluble biodegradable sulfonated detergents.

As is well known, the ever-increasing need for improved detergents and detergent compositions has resulted in the expenditure of a substantial amount of research time and attention. The particularly complicated physical and chemical phenomena here involved, however, have added a great deal of confusion to the art and have given rise a great plurality of conflicting theories and concepts. The complexity of the overall problem is readily appreciated when one considers the fact that the phenomena here involved include suspension, interfacial tension, micellar structure, dispersion, emulsion, foam stability and the like.

In addition to these complicated and interrelated phenomena, another problem has arisen in recent years and this involves very great resistance of many well known detergents to degradation biologically in the conventional septic or sewage systems employed. Detergents or surfactants which resist biodegradation in those systems are currently a source of considerable trouble. Contamination of drinking water sources by underground seepage of water containing surface active agents, wholly or partially remaining non-degraded, and excessive foaming of waste waters containing surfactants entering sewage treating plants, are recognized as two important problems resulting from the use of surface active agents which are not degradable or are relatively poorly degradable in nature. The ideal detergent would, of course, function with the best cleansing efficiency, or substantially that efficiency, in the ordinary cleansing operation for which it is used, but this ideal detergent would also be readily decomposed biologically in the processing of ordinary sewage. The biodegradability of the most popular present-day detergents, namely, the dodecylbenzene sulphonates (as conventionally derived from polypropylene polymer which is a predominately branched alkyl chain), leaves something to be desired (and it will be understood that hereinafter such branch chain compound is in the form of dodecylbenzene sulphonate referred to, unless otherwise specified). The invention provides a detergent that is at least the substantial equivalent of the dodecylbenzene sulphonate detergents in detergency function and performance, but which has the additional advantage of being biodegradable.

Another important aspect of this invention relates to novel liquid compositions of the synthetic detergents of the invention.

As pointed out in United States Patent No. 2,607,740, issued August 19, 1952 to Peter T. Vitale and Ralph Spencer Leonard, and assigned to Colgate-Palmolive-Peet

1,047,771



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Index

B11A,
B12E,
312K2,

ERRATA

SPECIFICATION No. 1,047,771
Amendment No. 1

- Page 2, line 54, for "cid" read "acid"
- Page 6, line 6, for "chocophenol" read "chalcophenol"
- Page 6, line 46, for "(a.)" read "(a₄)"
- Page 7, line 53, for "pars" read "parts"
- Page 8, line 53, for "bases" read "basis"
- Page 9, line 21, for "palmtic" read "palmitic"
- Page 9, line 31, for "compositions" read "composition" 5
- Page 9, line 48, for "ilycol" read "glycol"
- Page 11, line 39, for "moles" read "mols"
- Page 12, line 30, for "4" read "8"
- Page 13, line 16, for "otbains" read "obtains"
- Page 13, line 20, for "advantages" read "advantage" 10
- Page 14, line 1, for "maganous" read "manganous"
- Page 14, line 14, after "will" insert "be"
- Page 14, line 28, for "triethoxyethyl" read "trioxyethyl" 15
- Page 17, line 8, for "stablization" read "stabilization"
- Page 17, line 44, delete whole line and substitute " C_2-C_4 alkylol C_1-C_4 alkyl ammonium radical, or a $(C_2-C_4$ oxy-alkyl)_m C_2-C_4 ," 20
- Page 18, line 1, for "allylol" read "alkylol"
- Page 18, line 1, for "sulphate" read "sulphated" 25
- THE PATENT OFFICE
5th January 1967
- 30

ERRATUM

SPECIFICATION No. 1,047,771

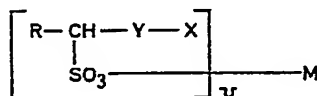
- Page 1, Index at acceptance, line 2, after "6B12B3" delete "6B12C6, 6B12C8, 6B12C9," line 4, after "6B12N4" insert "6C6, 6C8, 6C9,")

THE PATENT OFFICE
16th December 1966

Company, synthetic detergents of a type known as organic sulphates and sulphonates have been developed, and the detergents of this type have been found to have certain properties which render them much more suitable than ordinary soaps for certain uses. Since these detergents have many properties substantially different from the properties of soaps, and particularly, since they behave in a substantially different manner in aqueous solution, for example, by non-formation of insoluble precipitates in hard water, the improvement or alteration of the general behavior characteristics of these detergents has opened up an entirely new field of research. One of such fields of research involves certain attempts to correlate foaming and deterative power in connection with these detergents. The exact relationship between foaming and deterative power, in connection with these detergents, is not really fully understood, nor has it been definitely established that there is a particular relationship therebetween. On the other hand, it is highly desirable to have detergent compositions of this particular type which possess excellent foaming properties in combination with excellent deterative efficiency; and this particular combination of properties is of very appreciable importance in connection with consumer appeal for home use, as well as for industrial use.

It is important to appreciate, however, that a commercially suitable liquid detergent composition must necessarily have satisfactory properties in connection with the critical considerations such as viscosity, selective solvent, cloud point, foaming, grease emulsification, soil removal, adequate concentration and lack of irritants in the composition. Moreover, the increasing use of detergents has resulted in substantial concentrations thereof in sewage systems, with resultant complications because of the resistance of many of these detergents to biodegradation, so that still another critical consideration is satisfactory biodegradability in the detergent. In general, liquid detergent compositions heretofore known have left something to be desired in connection with one or more of the foregoing critical considerations.

A detergent composition according to the invention comprises a water-soluble sulphonated detergent (a_1) of the formula:



wherein

R is a C_4-C_{20} alkyl groups from a fatty acid,

Y is $\text{C}:\text{O}:\text{O}$, $\text{C}:\text{O}:\text{NH}$ or $\text{C}:\text{O}:\text{NX}'$

X is H , a C_1-C_6 alkyl radical, a $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$, a $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{O}$ (C_1-C_6) alkyl or a $(\text{C}_2-\text{C}_4 \text{ alkyleneoxy})_n-\text{H}$ radical wherein n is an integer from 1 to 10, provided X is not H when Y is $\text{C}:\text{O}:\text{O}$,

X' is X or H, and

M is a metallic ion, the ammonium radical, a C_2-C_4 alkylol ammonium radical, a C_2-C_4 alkylol C_1-C_3 alkyl ammonium radical or a $(\text{C}_2-\text{C}_4 \text{ oxyalkyl})_m \text{C}_2-\text{C}_4$ alkylol ammonium radical wherein m is an integer from 1-4; ν is the valency of M; the total number of carbon atoms in R and in any C-C chain in X being 8 to 24; and a water-soluble detergent (a_2) which consists of an alkali metal, alkaline earth metal, zinc, ammonium or C_2-C_4 alkylol ammonium salt of a sulphated $\text{C}_{10}-\text{C}_{22}$ fatty alcohol or alkoxylated $\text{C}_{10}-\text{C}_{22}$ fatty alcohol.

In addition to the foregoing detergents referred to as (a_1) and (a_2), a composition of the invention may be formed including other water-soluble detergents (a_3), (a_4) and (a_5); the detergents (a_1)-(a_5) will be collectively referred to as (a). Other components may also be included such as a detergent builder (b), an alkylolamide (c), a chelating agent (t) and soap (x).

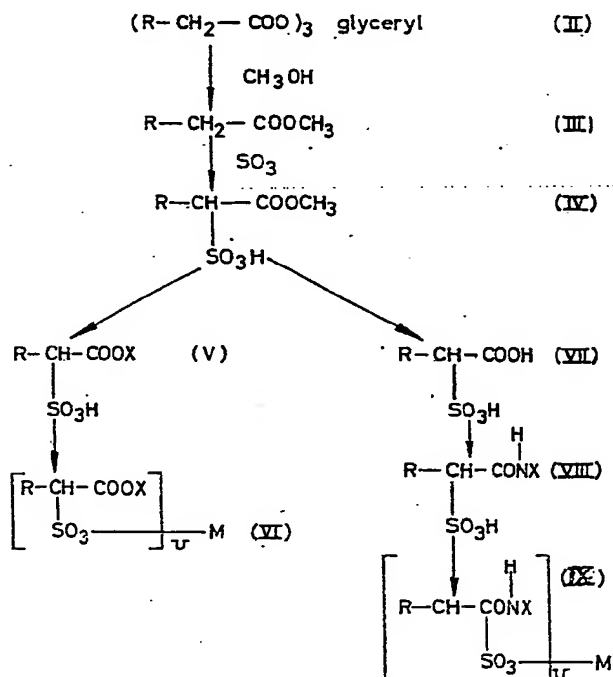
The detergent (a_1) functions with very high deterative efficiency and also is readily biodegradable in the naturally occurring and/or specially prepared environment of septic and sewage systems (or in the presence of the essential bacteria, enzymes, etc. present in these environments).

The detergent (a_1) is a salt of an alpha-sulpho fatty ester or amide, and the latter may be prepared by the alpha-sulphonation of a fatty acid foundation having the following general formula:



wherein R is a C_4-C_{20} fatty acid alkyl residue. The fatty acid foundation (I) is preferably an ester at the time it is sulphonated, although it can be alpha-sulphonated

as the acid per se (I). The radical R in the acid (I) is a typical C_4-C_{22} fatty acid residue, i.e. it is a fatty acid residue containing from 4 to 20 carbon atoms, so that the fatty acid foundation (I) is that of a C_6-C_{22} fatty acid. Such fatty acids include hexanoic (caproic), heptanoic (enanthic), octanoic (caprylic), nonanoic (pelargonic), decanoic (capric), undecanoic (hendecanoic), dodecanoic (lauric), tridecanoic; tetradecanoic (myristic), pentadecanoic, hexadecanoic (palmitic), heptadecanoic (margaric), octadecanoic (stearic), nonadecanoic, eicosanic (arachidic), heneicosanic; and docosanic (behenic) acids. The acids preferred in this use are palmitic and stearic, which makes the radical R preferably a $C_{14}-C_{16}$ radical (i.e. tetradecyl to hexadecyl radical). The sulfo group replaces one of the hydrogens on the alpha carbon in the fatty acid base material (I) just described and this alpha-sulfonation may be carried out by sulfonating the fatty acid per se (in a suitable solvent) or a salt of the fatty acid (also in suitable solvent) with a conventional sulfonating agent such as oleum, chlorosulfonic acid or sulfur trioxide (SO_3). Preferably, however, the alpha-sulfonation is carried out in the practice of the invention by the sulfonation of a suitable ester of the fatty acid, such as the methyl ester; and the general scheme for preparing the compounds of the invention is set forth hereinafter:



It will be seen from the foregoing that one may start with a suitable natural oil or fat that is a triglyceride of one of the foregoing fatty acids, which fatty acids are preferably saturated by an initial hydrogenation procedure, and then by transesterification replace the glyceryl group by a methyl group so as to obtain the methyl fatty acid ester (III). A hydrogenation step can be alternatively employed by subjecting the derived methyl ester to hydrogenation after transesterification and isolation of the resultant methyl ester. This is next sulfonated with SO_3 to obtain the alpha-sulfonic acid of the methyl ester (IV). This general procedure is preferred for use in the practice of the invention, for the reason that the methyl ester (III) is easily produced with economic advantage of producing the by-product glycerol; and the sulfonation of the methyl ester (III) with SO_3 is carried out without the necessity for any additional solvents or other complications so as to obtain the alpha-sulfonic acid (IV).

Next, in the preparation of the ester compounds of the type employed in the practice of the invention, one may carry out additional transesterification, if desired, to replace the methyl group with another ester group X, which will be defined in further detail hereinafter, and neutralize the alpha-sulfo group with M, which will also be defined hereinafter. In contrast, if it is desired to prepare an amide for use in the practice of the invention, the initial alpha-sulfonated methyl ester (IV) is prefer-

ably converted to an alpha-sulfo fatty acid (VII) or its corresponding acid chloride, which in turn is converted to the amide (VIII) and neutralized to obtain the amide (IX) used in the practice of the invention.

5 The neutralization of the alpha-sulfonic acid group is a conventional procedure for neutralizing sulfonic groups in detergent materials, which involves merely reaction with a suitably alkaline material to obtain the $-\text{SO}_3\text{M}$ group, wherein M is an alkali metal (sodium and potassium being preferred, but lithium, etc. also being usable), ammonium, or alkaline earth (or any suitable neutralizing metallic ion from Group II of the Periodic Table, which includes magnesium, calcium, zinc, strontium, barium, etc.). In this last-mentioned instance M may be a $-\text{CaOH}$ group in a basic salt, but in the typical neutralized salt M is the typical di-valent cation of the metal, e.g., $-\text{Ca}-$ in a salt wherein both valences are satisfied by the sulfo groups of esters (V) and/or amides (VIII). In addition, the alpha-sulfonic acid group may be neutralized with a C_2-C_4 alkylol amine and, optionally, with a C_1-C_4 alkylamine additionally, so as to obtain the corresponding C_2-C_4 alkylol ammonium radical or alkylol alkyl ammonium, wherein there may be one to three ethanol, propanol and/or butanol radicals attached to the ammonium N. Such radicals include monoethanol, diethanol, triethanol, monopropanol, dipropanol, etc., monobutanol, etc. ammonium radicals. In this respect, M is preferably a monoethanol or a diethanol or a triethanol ammonium group. In addition, such radicals include alkylol ammonium groups which may be reacted with C_2-C_4 alkylene oxides to obtain alkoxyated compounds, wherein the radical M will be a $(\text{C}_2-\text{C}_4 \text{ oxyalkyl})_m \text{C}_2-\text{C}_4$ alkylol ammonium group, wherein m is an integer from 1 to 4. This group is prepared by conventional alkoxylation of the corresponding alkylol ammonium group, and it is possible to modify the hydrophobic-hydrophilic characteristics of the molecule by such alkoxylation procedure, although in the practice of the instant invention it is generally preferable to carry out such alkoxylation with 1 to only 4 mols of the alkylene oxide per mol of the alpha-sulfo compound. The alkylene oxide thus used is preferably ethylene oxide, although propylene or butylene oxide may be used in the practice of the instant invention; or mixtures thereof may be used. For example, a monoethanol ammonium radical, may be ethoxylated with about 2 to 3 mols of ethylene oxide to obtain a particularly satisfactory radical M for use in the practice of the present invention.

35 The compounds (a_1) wherein Y is $\text{C}:\text{O}:\text{NX}'$ are preferably made merely by selection of the amine (i.e. HNXX') which is used to obtain the amide (VIII) by reaction of such amine and the acid (VII) or its equivalent, such as the carboxyl chloride, e.g., alpha-sulfo myristoyl chloride which is reacted with dimethyl amine to produce N,N-dimethyl alpha-sulfo myristamide (which may or may not result in a dimethyl ammonium group associated with the alpha-sulfo radical, but which group is readily replaced by other neutralizing radicals M if desired).

40 Moreover, it must be appreciated that the polyvalent metal salts of the invention that are employed in detergent formulations usually possess less water-solubility or dispersibility per se than their alkali metal counterparts; but it will be seen that particularly the Group II metal salts of the intermediate atomic weight range (of 24 to 137) possess adequate functional water-dispersibility in the environment of their use to obtain the advantages of the invention. Unless otherwise specified the Group II metals referred to herein are intended to mean primarily the non-toxic intermediate members of this group (i.e. Mg, Ca, Zn, Sr, Ba) suitable for detergent use, although it will be appreciated that for other special purposes the various other Group II metals (such as Be) may be used, including the toxic salts of Hg, Ra, Cd. The preferred salts for detergent uses are those of the lower atomic weight (24 to 65) metals Mg, Ca and Zn.

55 In the detergent (a_1) , the radical X may be a C_1-C_6 alkyl group in that it may be methyl (which is preferred for use in the practice of the invention and which is also preferred for use in transesterification to obtain compound (III) from the starting material (II) hereinafter referred to). The radical X may also be ethyl, propyl, isopropyl, butyl, sec.-butyl, isobutyl, amyl, isoamyl, hexyl, etc., or mixtures thereof and in each case the preferred procedure involves transesterification with the methyl compound using the corresponding ethyl, propyl, butyl, etc. alcohol to obtain the desired radical in the position X.

60 The radical X may also be a glyceryl or glycceryl ether radical. Again, the methyl radical in the X position can be replaced by the glyceryl or glycceryl ether group (i.e. $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$ or $-\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{O}$ (C_1-C_6 alkyl) groups), wherein the C_1-C_6 alkyl group just mentioned may be any of the typical alkyl groups such as methyl, ethyl, propyl, etc. up to and including hexyl. This may be done in, for example, the compound (V) merely by transesterification, or in the compound (IX) either by

replacement of an alkyl group or replacement of a hydrogen on the amide group (by conventional synthesis).

In addition, the group X may be selected from $(C_2-C_4 \text{ alkyleneoxy})_n-H$ groups wherein n is an integer from 1 to 10. It will be appreciated that the methyl ester (III) may be converted to a corresponding ethylene or polyethylene glycol ester of the general formula (V) merely by transesterification reaction with a glycol. Any such C_2-C_4 alkylene glycol ester may then be used as such in the practice of the invention or it may be alkoxyated with from 1 to 10 mols of ethylene oxide, propylene oxide and/or butylene oxide. Again, the alkoxylation process is conventional per se. Such a compound might thus be referred to as the sodium alpha-sulfo ethylene glycol stearate ester, ethoxylated with 6 mols of ethylene oxide.

As previously indicated, the detergent (a_1) is a water-soluble detergent. Moreover, in the concentrated form herein described, using a typical selective solvent for these materials, such as an ethanol-water system, the detergent (a_1) is also apparently soluble. In this respect, excessively great carbon-to-carbon chain lengths in the molecule tend to subtract from water-solubility, and it has been found that the total number of carbon atoms in any C to C chain in X plus the total number of carbon atoms in R should be within the range of a practical minimum of 8 to a practical maximum of 24. In order for a detergent to function adequately there must be some minimum carbon-to-carbon chain length in the molecule. In computing the foregoing range, it will be appreciated that the radical R is composed of a carbon-to-carbon chain, so the total number of carbon atoms in the radical R is computed as such. In the radical X, however, the carbon-to-carbon chain may be simply in the form of an alkyl group (in which case all of the carbon atoms in the chain would be added to the total) or there may be only a number of short C_2-C_4 alkylene groups in the molecule separated by oxygens, as a result of alkoxylation. In such case, the total number of carbon atoms in a given chain in the radical X would be the 2, 3 or 4 carbon atoms in a given ethylene, propylene or butylene chain, even though the alkoxy units were repeated a number of times in the radical X. It will thus be seen that by this computation the total number of carbon atoms in radicals R and X in, for example, the sodium alpha-sulfo butyl stearate would be 16 plus 4 or 20, whereas the total number of carbon atoms in sodium alpha ethylene glycol stearate ethoxylated with 6 mols of ethylene oxide will be computed as 16 for R and only 2 for X, for a total of 18 carbon atoms.

The water-soluble detergent designated (a_2) is a $C_{10}-C_{22}$ sulfated fatty alcohol that is neutralized with an alkali metal (preferably sodium or potassium, although lithium or other alkali metals might be used), an alkaline earth metal, (such as magnesium, calcium, strontium, and barium), zinc, ammonium or C_2-C_4 alkylol ammonium group (such as mono-, di, tri-ethanol, propanol or butanol ammonium groups). The sulfated fatty alcohols are well known materials, which are obtained by preferably initial hydrogenation of the corresponding fats or oils to convert the fatty acyl groups therein to the so-called fatty alcohols, which include decyl, undecyl, dodecyl (lauryl), tridecyl, tetradecyl (myristyl), pentadecyl, hexadecyl (palmityl), heptadecyl, octadecyl (stearyl), nonadecyl, arachidyl, docosanyl, etc. fatty alcohols. The sulfation thereof is carried out using conventional sulfating agents such as chlorosulfonic acid and oleum. Alkoxylation of the fatty alcohols (prior to sulfation) to modify the properties of the resulting detergent (a_2) is well known, and the fatty alcohols thus used and referred to herein include the known $(C_2-C_4 \text{ oxyalkyl})_m C_{10}-C_{22}$ fatty alcohols, wherein m is an integer from 1 to 50. Preferred for use in the practice of the instant invention are sodium lauryl sulfate and triethanol ammonium lauryl sulfate. The sulfated fatty alcohol detergents (a_2) have excellent deterative efficiency and also possess biodegradability. These materials (a_2) are found to be unusually effective in the practice of the invention when used in combination with the alpha-sulfo detergents (a_1), for the reason that these two types of detergents cooperate with each other to effect a very high degree of deterative action, and they are both biodegradable. In addition, the use in combination of these two detergents (a_1) to (a_2) results in certain economic advantages. Preferably the weight ratio of (a_1) to (a_2) ranges from about 10:1 (above which the synergistic effect resulting from the use of ingredient (a_2) is diminished) to about 1:5 (which is a practical minimum for obtaining the essential benefits of ingredient (a_1) when these two detergents are used in combination).

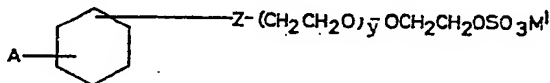
An additional water-solubilized detergent which may optionally be used in the practice of the invention is designated (a_3) which is a water-solubilized alkyl chalcophenol polyalkyleneoxide condensate having 6 to 12 carbon atoms in the alkyl group. In other words, the alkyl group on the phenol is a C_6-C_{12} alkyl group which may be hexyl, heptyl, octyl, nonyl, decyl, undecyl, or dodecyl radical. Commercially avail-

able nonyl phenol and octyl (and isoctyl) phenols and thio phenols have been found to be particularly satisfactory for use in the practice of the invention in the formation of detergent (a_3).

As is well known, the elements of Group VIB of the Periodic System are known as chalcogens, and the two lower members of this Group are oxygen and sulfur. Accordingly, the term "chocophenol" is used herein as the generic term for the two species phenol and thio phenol.

Polyalkoxide condensation products of these alkyl phenols or thio phenols are well known in the trade and are obtained by condensing the particular phenol or thio phenol with a suitable C_2-C_2 alkylene oxide, such as ethylene oxide or propylene oxide. The number of alkoxide groups in the molecule is the number generally referred to as the mols of alkylene oxide employed in alkoxyating the particular phenol compound. Preferably, the phenol compound here employed is alkoxyated with from 2 to 16 mols of ethylene or propylene oxide; and it thus contains from 2 to 16 alkoxide groups. One compound which may be used in the practice of the invention is nonyl phenol ethoxylated with 9 to 10 mols of ethylene oxide. Another compound which may be used in the practice of the invention is nonyl thio phenol ethoxylated with 3 to 4 mols of ethylene oxide. The amount of detergent (a_1) used in the practice of the invention is preferably a comparatively small amount. For example, the weight ratio of detergent (a_1) to detergent (a_2) may range from a practical maximum of about 10:1 to a practical minimum of about 1:2. Also, it is preferable to employ a weight ratio of (a_1) plus (a_2) to (a_3) of from 10:1 to 1:2. In other words, the total amount of ingredient (a_1) and (a_2) would equal 10 compared to a practical minimum of about 1 for ingredient (a_3).

Still another ingredient that may be used in the practice of the invention is the sulfated and neutralized form of ingredient (a_2), which is herein designated ingredient (a_4). Ingredient (a_4) is a water-solubilized sulfated alkyl chalcophenol polyalkoxide condensate having 6 to 12 carbon atoms in the alkyl group, one of the two lower chalcogens in the chalcophenol group, and 2 to 16 alkoxide groups each containing 2 to 3 carbon atoms in the molecule. In addition, the polyalkoxy chain is sulfated and neutralized so as to obtain a general molecular structure of the following type:



(XI)

wherein A is a C_6-C_{12} alkyl group, Z is O or S, and y is 1 to 15 (in this case referring to ethoxide groups), M' is any suitable "neutralization" radical or base selected from the previously mentioned alkali and alkaline earth metals, ammonium and C_2-C_3 alkylol ammonium groups (such as mono-, di-, tri-, ethanol, propanol or butanol ammonium radicals). The neutralized sulfated nonyl phenols and nonyl thio phenols are available commercially. A preferred compound for use in the practice of the instant invention is sodium or triethanol ammonium sulfated nonyl phenol ethoxylated with 5 mols of ethylene oxide.

The ingredient (a_4) has been found to enhance the overall deterative efficiency of the detergent component (a) and it may be used in combination with the previously-mentioned ingredient (a_1), but with or without the ingredient (a_3). Preferably the weight ratio of ingredient (a_1) to ingredient (a_4) ranges from about 10:1 to about 1:2. In the event that ingredient (a_1) is incorporated in the overall detergent combination (a), with or without ingredient (a_3), then the weight ratio of ingredient (a_1) plus the amount of ingredient (a_2) and any (a_3) present as against the total weight of ingredient (a_4) is preferably within the range of about 10:1 to about 1:2.

It should also be noted that detergents (a_1) and (a_2) are biodegradable as well as being particularly compatible with the previously mentioned detergents. Detergent (a_4) is generally classifiable as a nonionic detergent, whereas detergents (a_1), (a_2) and (a_3) are anionic detergents.

Still another detergent which may be used in the practice of the invention is a water-miscible anionic detergent (a_5) which is a sulfonated alkyl aryl compound neutralized with a suitable base such as the previously mentioned alkali and alkaline earth metal, ammonium, and C_2-C_3 alkylol ammonium bases or groups. In detergent (a_5) the alkyl group contains from about 6 to 20 carbon atoms and the aryl group contains 1 or 2 benzene nuclei. The anionic detergents of this group (a_5) are the

most widely known and used detergents at the present time and one of the more common members of this class, namely, sodium dodecylbenzene sulfonate is known to be a particularly efficient detergent. In instances where extremely efficient deterative action or deterative action peculiar to the alkyl aryl sulfonate detergents is required, comparatively small amounts of ingredient (a_s) may be added to the overall detergent combination (a) herein involved. In general, the weight ratio of the other portion of the detergent combination (a), which would be (a₁) plus (a₂) or (a₁) plus (a₂) plus any amounts of (a₃) and/or (a₄) which are employed, to the amount of (a_s) ranges from about 20:1 to 5:1 (and in exceptional cases to 1:1).

In the conventional procedure for preparing dodecylbenzene sulfonate a branched chain alkyl substituent is prepared on the benzene ring, and it has been found that the biodegradability of this branched chain, in particular, leaves something to be desired. Thus, in order to obtain maximum biodegradability while using ingredient (a_s), it is preferable to use a form thereof wherein the alkyl group is a straight chain alkyl group. (For that matter, it is preferred that the alkyl groups in any of the previously mentioned or subsequently mentioned materials used in the practice of the instant invention be a straight chain rather than a branched chain alkyl group). On the other hand, in the case of ordinary use of detergents in rural areas where septic systems are used for individual homes, the incorporation of comparatively small amounts of such detergents as sodium dodecylbenzene sulfonate (of the type now available commercially) will ordinarily not have any harmful effect with respect to the biodegradability, whereas the special deterative efficiency of the sodium dodecylbenzene sulfonate for certain purposes may have a compensating advantage. It is for this reason that the sodium dodecylbenzene type (a_s) detergent may be used in comparatively small amounts in the practice of the invention.

Another ingredient which may be included in small amounts in the composition of the invention is ingredient (b) which is a water-soluble detergent builder that is an alkaline reacting salt of a weak inorganic acid. These "builders" are well known and are used to a great extent in the art in a number of heavy duty cleaning formulations. Preferred compounds include sodium tripolyphosphate, trisodium phosphate, sodium silicate, alkali metal carbonates, etc. These materials are all inorganic salts of sufficiently weak acids to have very alkaline pH's in aqueous systems. These inorganic builders may be used directly in combination with the detergent component (a) to form dry particulate free-flowing cleansing compositions, or they may be used in combination with selective solvents to form liquid concentrates useful in cleansing compositions. Preferably the weight ratio of the detergent component (a) to the inorganic builder (b) may range from 20:1 to about 1:20, most preferably 10:1 to 1:2.

Typical dry compositions according to the invention include the following:

COMPOSITION (1)

25 parts of sodium methyl alpha-sulfo palmitate
25 parts of sodium tripolyphosphate
5 parts of sodium lauryl sulfate

COMPOSITION (2)

50 parts of sodium methyl alpha-sulfo stearate
50 parts of trisodium phosphate
5 parts of sodium lauryl sulfate
5 parts of nonyl phenol ether of decaethylene glycol

COMPOSITION (3)

25 parts of sodium isopropyl alpha-sulfo palmitate
75 parts of sodium tripolyphosphate
5 parts of triethanolamine lauryl sulfate
2 parts of nonyl phenol ether of decaethylene glycol
2 parts of sodium neutralized sulfate of nonyl phenol ether of decaethylene glycol

COMPOSITION (4)

25 parts of sodium methyl alpha-sulfo stearimide
75 parts of sodium tripolyphosphate
5 parts of sodium lauryl sulfate

COMPOSITION (5)

- 25 parts of sodium ethylene glycol alpha-sulfo palmitate
 50 parts of sodium tripolyphosphate
 2 parts of triethanol ammonium lauryl sulfate
 5 2 parts of isooctyl thiophenol ethoxylated with $3\frac{1}{2}$ mols of ethylene oxide 5
 2 parts of sodium dodecylbenzene sulfonate

The sodium, ammonium or triethanol ammonium dodecylbenzene sulfonates may be added in a quantity of, for example, 3 parts to each of the foregoing compositions so as to obtain certain advantages in deterative efficiency for some uses, but the biodegradability of the compositions of the invention such as those just specified is distinctly superior if the dodecylbenzene sulfonate detergent component is omitted. 10

In addition, each of the foregoing compositions may be formulated as a liquid in a 20% concentrate in a solvent as described hereinafter, such as equal parts of ethanol and water, to obtain a water-miscible concentrate having superior properties. 15

Also particularly useful in the practice of the invention is an alkylol amide (c) which is used in small amounts for foam stabilization, satisfactory foam formation, and other desirable properties in the foam, and which is also found to have an unusual additive aspect with respect to the overall deterative efficiency of the composition, even though it is used in only comparatively small proportions of about 1% to about 20 5% of the total weight of (a) plus (b). The preferred amount is about 1 to 2% of ingredient (c) based upon the total weight of (a) and (b). The alkylol amide has the following formula: 20



wherein $\text{R}'-\text{CO}$ is a $\text{C}_{10}-\text{C}_{20}$ fatty acyl radical, R'' is H , C_1-C_4 alkyl or R''' , and R''' is selected from C_2-C_4 alkylol groups and condensates of 2 to 5 mols of C_2-C_4 alkylene oxide with such C_2-C_4 alkylol groups. Preferably, the weight ratio of (a):(c) is 20:1 to 1:2. 25

The alkylol amide (c) may be replaced at least in part by an amine oxide described hereinafter. 30

It will thus be seen that the radical $\text{R}'-\text{CO}-$ is a fatty acyl radical derived from decanoic (capric), undecanoic (hendecanoic), dodecanoic (lauric), tridecanoic, tetradecanoic (myristic), pentadecanoic, hexadecanoic (palmitic), heptadecanoic (margaric), octadecanoic (stearic), nonadecanoic or eicosanic (arachidic) acids. 35

It will also be noted that R'' may be hydrogen (as would be the case if the instant amide were formed from a primary amine) or it may be R''' (which would be the case if the amide were formed from a secondary amine). The radical R''' may be a C_2-C_4 alkylol group, such as ethanol, propanol, or butanol groups, or it may be a condensation of 2 to 5 mols of a C_2-C_4 alkylene oxide with such C_2-C_4 alkylol groups. Again, the condensation with ethylene, propylene, and/or butylene oxide is well understood in the art. Typical examples of ingredients (c) include N,N bis (2-hydroxyethyl) lauramide, N,N bis (2-hydroxyethyl) myristamide, N,N bis (2-hydroxyethyl) capramide, lauric monoisopropanol amide, etc. 40

Still another aspect of the invention involves the combination of soap (x) in or the incorporation in soap in flake or bar form of the previously mentioned combination of surfactants (a), (b) and optionally (c). In general, if soap is to be employed, it is employed in amounts sufficient to economically replace an appreciable portion of the surfactant components (a), (b) and (c) without subtracting from the overall heavy duty deterative effect of the composition. The various weight ratios and ranges already set forth in connection with ingredients (a), (b) and (c) would still apply, but on the basis of a total of, for example, 100 parts of the aforementioned combination of (a) and (b), and optionally (c), the amount of soap used may vary from as little as about 5 parts by weight to as much as about 100 parts by weight, and in exceptional cases (when a soap-detergent bar is contemplated) the amount of soap used on this bases may be as much as 150-180 parts by weight. In general, the weight ratio of the detergents (a_{1-5}) to the soap (x) ranges from 10:1 to 1:20, preferably, this ratio is from 5:1 to 1:5. Where the builder (b) is present, the weight ratio of (a_{1-5})+(x):(b) is 1:1 to 1:5. 45 50 55

By way of example, heavy duty detergent compositions are prepared by adding 40 parts of sodium coconut soap to each of Compositions (1) through (5) previously

described. Also, detergent-soap bars that have particular suitable lime soap dispersing properties are prepared by adding each of the Compositions (1) through (5) to 160 parts by weight of sodium tallow soap in a melt and then casting the melt into bars in conventional fashion.

Soap is a well known material available commercially which is chemically a salt of a fatty acid or a mixture of fatty acids. Usually it is defined as a chemical compound or mixture of chemical compounds resulting from the interaction of fatty oils and/or fats with alkali. For example, the soap obtained by the reaction of tallow with alkali is generally referred to as "tallow soap" and the soap obtained by the reaction of coconut oil with alkali is generally referred to as "coconut soap"; and these are the more common types of soaps commercially available.

The surfactants of the invention have been found to be compatible with the soap in the bar; they have been found to be perfectly compatible under the conditions of mixing with the molten soap, adjusting the moisture content, casting, cooling and subsequent cutting up of the cast soap; and the resulting soap is found to possess lime soap dispersing properties corresponding to the active content of the (lime soap dispersing agent or) surfactant in the composition of the present invention.

Considering tallow and coconut oil as preferred fatty materials for the manufacture of soap and sodium and potassium alkalis (hydroxides, carbonates, etc.) as the preferred alkalis for the manufacture of soap, it will be noted that the fatty acid component of tallow is about 30% C_{16} acid (i.e. palmitic) and about 70% C_{18} acid (stearic and oleic) and the fatty acid component of coconut oil is about 50% C_{12} (lauric) and about 20% C_{14} (myristic) acid, with the remainder being minor amounts of other acids such as caprylic, capric, palmitic, stearic, oleic and linoleic. Soaps are then preferably sodium and/or potassium salts of essentially C_{12} — C_{18} fatty acids.

In preparing a liquid detergent composition according to the invention, any suitable solvent may be employed as the liquid medium or selective liquid solvent. Such solvent should possess several essential characteristics, since it functions as a critically important and integral part of the composition. It must, of course, be chemically inert with respect to the ingredients to be dissolved therein, as well as the ingredients or materials with which the compositions would ordinarily come into contact during normal use. The solvent must have a definite solubilizing action on the solids of ingredients (a), (b) and (c), having substantial solubility for these ingredients in combination. The solvent should be water-miscible or water-soluble, since the present compositions are intended for use, at least partially, in aqueous solutions. The solvent should possess a relatively low viscosity in order to impart to the composition proper fluidity, and it should possess reasonably good stability to temperature changes generally, to heat, to chilling, to light, etc. It has been found that a low molecular weight hydroxyl-containing solvent may be most suitably employed. In particular, a suitable liquid solvent medium may be selected from the group consisting of water, low molecular weight alcohols and mixtures thereof. The alcohol should preferably be the saturated aliphatic type, i.e., alkanols; and such alcohols may be mono or polyhydric in character and may contain inert solubilizing groups such as ether linkages. Examples include ethyl alcohol, *n*-propyl alcohol, isopropyl alcohol, and closely related solvents. Ethyl alcohol is most preferred, in general, since it is readily miscible with water and it has a minimum amount of characteristic odor which might, for example, interfere with the use of perfumes in the composition. Other solvents include polyhydric alcohols such as ethylene glycol, propylene glycol and glycerol and the like; and ether linkage containing solvents such as monomethyl ether of ethylene glycol, monoethyl ether of ethylene glycol, diethylene glycol, diethylene glycol monomethyl ether, monobutyl ether of diethylene glycol, monomethyl ether of diethylene glycol, dioxan and the like. Most preferably, water and a monohydric aliphatic alcohol (or a mixture of such alcohols) are used in about equal volume parts. It is also preferred to use water, the aliphatic monohydric alcohols and the dihydric alcohols of about 2 to about 4 carbon atoms, and the lower alkyl ethers of said dihydric alcohols and mixtures thereof.

The concentration by weight of ingredients (a) plus (b) in the solvent may range from 5% to 60 or 70%.

In general, the ingredients (a) and (c) may be admixed with the solvent and dissolved therein in any convenient manner, which includes pre-mixing ingredients (a) and (c) initially without the solvent.

Sometimes, it is preferred to melt the ingredient (c) and stir the same into warm water, water and alcohol, or the alcohol solution of the detergent (a), or merely to admix the alcohol-water solution of the ingredient (c) with the detergent (a).

Subsequent dilution of suitable solutions of the ingredients (a) and (c) may be carried out as desired. As will be appreciated, the amount of total solids in a given liquid composition will vary and will be limited to an appreciable extent by the degree of solubility in the liquid medium. On the other hand, the invention is concerned principally with a concentrated liquid detergent solution, and it affords advantages in that the ingredients (a) and (c) may be incorporated in suitably concentrated solution, so that (a) plus (c) may be at least about 5 weight % of the selective solvent therefor, and is preferably at least about 40 weight %. The maximum weight % may range as high as about 70 weight %, depending upon the solubilizing ability of the particular solvent. A preferred range is about 10 to 40 weight %, with the concentration of ingredient (c) being at least about 2 weight % and preferably about 10 to about 20 weight %.

Typical liquid formulations employed in the practice of the invention are set forth hereinafter, and it will be found that these formulations are particularly useful in dishwashing among other uses.

COMPOSITION (6)

40 parts of ammonium methyl alpha-sulfo palmitate
 5 parts of lauroyl diethanolamide
 5 parts of sodium lauryl sulfate
 35 parts of ethanol
 15 parts of water

COMPOSITION (7)

35 parts of sodium methyl alpha-sulfo palmitate
 5 parts of caproyl diethanolamide
 5 parts of triethanolamine lauryl sulfate
 5 parts of nonyl phenol ethoxylated with 8½ mols of ethylene oxide
 35 parts of ethanol
 15 parts of water

COMPOSITION (8)

35 parts of sodium isopropyl alpha-sulfo palmitate
 5 parts of lauroyl monoethanolamide ethoxylated with 4 mols of ethylene oxide
 5 parts of triethanol ammonium neutralized sulfated nonyl thiophenol ethoxylated with 8 to 10 mols of ethylene oxide
 5 parts of ammonium lauryl sulfate
 35 parts of ethanol
 15 parts of water

COMPOSITION (9)

35 parts of sodium methyl alpha-sulfo palmitate
 5 parts of lauroyl diethanolamide
 5 parts of triethanol ammonium lauryl sulfate
 5 parts of triethanol ammonium neutralized sulfate of nonyl phenol ethoxylated with 9 mols of ethylene oxide
 25 parts of ethanol
 10 parts of isopropanol
 15 parts of water

COMPOSITION (10)

25 parts of sodium methyl alpha-sulfo stearamide
 10 parts of lauroyl diethanolamide
 10 parts of sodium lauryl sulfate
 5 parts of nonyl phenol ether of decaethylene glycol
 35 parts of ethanol
 15 parts of water

COMPOSITION (11)

35	parts of sodium ethylene glycol alpha-sulfo palmitate	
5	parts of stearyl diethanolamide	
5	parts of sodium lauryl sulfate	
5	parts of nonyl phenol ether of decaethylene glycol	5
2	parts of sodium neutralized sulfate of nonyl phenol ether of decaethylene glycol	
35	parts of ethanol	
15	parts of water	

As previously indicated, the alkyl aryl sulfonates (a₃) may be used to advantage in the practice of the invention for improving deterative efficiency in certain formulations, and 2 to 3 parts of sodium, ammonium or triethanol ammonium dodecylbenzene sulfonate may be added to each of the foregoing compositions so as to obtain improvements in deterative efficiency for certain purposes; but it will be appreciated that these conventional dodecylbenzene sulfonate compounds resist biodegradation. The biodegradability of previous compositions (6) to (11) has been found to be particularly satisfactory.

Liquid detergent compositions are prepared by adding 20 parts of (x) sodium coconut soap to each of the compositions (6) to (11) previously described.

Usually such surfactants would be incorporated in the form of an aqueous solution in an aqueous soap system. In any event, however, a subsequent drying treatment would not be required in the practice of the invention, because it is usually necessary only to add the soap with the other surfactant materials to the solvent system employed. In this respect, it may be necessary to incorporate conventional solvent "couplers" or "hydrotropes" (e.g. sodium toluenesulfonate) to assist in effecting an adequate solution of the surfactants in the selected solvent.

To illustrate the use of the inorganic builders (b), composition (6) may be modified by the addition thereto of 1 part of sodium silicate or sodium disilicate.

Compositions (7) to (11) may also be modified by the addition thereto of 2 parts of sodium tripolyphosphate.

Our co-pending Application No. 24357/66 (Serial No. 1,047,772) divided from the present application describes and claims polyvalent metal salts of the formula (a₁) which are per se new and useful as hereinafter indicated:

(A) *Group II metal salts*

The Group II metal salts of the compounds (a₁) are prepared usually by conventional (manipulative) neutralization procedures:

(A—1) One mol of calcium oxide (or hydroxide) is heated gently to about 40—50°C. with one mol of a methyl alpha-sulfo myristate to obtain the basic salt. If two moles of the methyl alpha-sulfo myristate are used, the neutralized salt is obtained.

(A—2) Comparable results are obtained using, in place of the methyl alpha-sulfo myristate in (A—1), methyl alpha-sulfo caproate, heptanoate, caprylate, pelargonate, caprate, hendecanoate, laurate, tridecanoate, pentadecanoate, palmitate, margarate, stearate, nonadecanoate, arachidate, heneicosanate and behenate esters.

(A—3) Corresponding compounds are obtained from the basic calcium salts of (A—1) or (A—2) by transesterification thereof with an equimolar proportion of ethanol, isopropanol, butanol, sec.-butanol, amyl alcohol, isoamyl alcohol, hexyl alcohol, glycerol, methoxy glycerol, ethoxy glycerol, isobutoxy glycerol, hexyloxy glycerol and ethylene glycol. In each case this reaction is carried out preferably by heating the ingredients at a temperature substantially higher than that sufficient to volatilize methanol (65°C.)

Excesses of monohydric alcohols may be used, over an equimolar proportion, to accelerate the reaction and compensate for evaporation losses; but with polyvalent metals more reactive than calcium toward alcoholic hydroxy groups, this is not done. Excesses of (higher boiling) polyhydric alcohols need not be used, but in any event makeup alcohol can be added from time to time to compensate for evaporation losses.

(A—4) The procedure of (A—3) is used with the neutralized calcium salts of (A—1) and (A—2) except that twice as much alcohol is used.

(A—5) The neutralized or basic calcium ethylene glycol alpha-sulfo esters of (A—3) and (A—4) may be readily alkoxylated by conventional (manipulative) steps (using sodium methylate catalyst and 1 to 9 mols of ethylene oxide, 50—50 ethylene-propylene oxide, propylene oxide and/or butylene oxide). The alkoxide is preferably formed by transesterification of the alpha-sulfonic acid methyl ester with the desired polyalkylene glycol, and neutralization with the polyvalent metal (base) is carried out

subsequently. With the calcium salts of the invention either procedure is used (the latter being preferable with basic calcium salts).

(A—6) An alternative route for calcium salts thus involves the transesterification of the alpha-sulfonic acid methyl ester of myristic acid (or any of the carboxylic acids of section (A—2) hereof) with any of the alcohols of the procedure (A—3 hereof, and the alkoxylation of (A—5) is carried out when appropriate; and the resulting alpha-sulfonic acid ester is then reacted with from one-half to one mol of calcium oxide (base) to obtain the neutralized or basic salt (respectively).

(A—7) For the corresponding amide salts the route of (A—6) is preferred. After sulfonation of the methyl ester of any of the acids of (A—2), this methyl ester is converted to the carboxylic acid (VII) or its corresponding acid chloride, which is reacted with the desired amine to form the amide. Thus alpha-sulfo myristoyl chloride and methyl amide are reacted under conventional conditions to obtain N-methyl alpha-sulfo myristamide; which is in turn neutralized with one-half or one mol of calcium oxide to obtain, respectively, the neutral and the basic calcium N-methyl alpha-sulfo myristamide. Using the alpha-sulfo carboxylic acid chlorides of the acids of (A—2) and such compounds as ammonia, mono- or di-methyl, ethyl, isopropyl, sec-butyl, n-amyl and n-hexyl amine; glyceryl amine; methoxy-, ethoxy-, isopropoxy-, isopropanol or butanol amine; one obtains the corresponding amide. Neutralized magnesium alpha-sulfo myristamide and N,N-dimethyl alpha-sulfo myristamide may thus be obtained by neutralization with MgO. In the case of alkylol amides, e.g. N-ethylol alpha-sulfo myristamide, alkoxylation is carried after neutralization (e.g. with CaO) as described in (A—5) to obtain the corresponding alpha-sulfo compound, e.g. the calcium salt of N-tetraethoxy ethylol alpha-sulfo myristamide or N-ethylol alpha-sulfo myristamide ethoxylated with 4 mols of ethylene oxide. Alternatively, such N-ethylol alpha-sulfo myristamide may be alkoxyated as described (e.g. after first being neutralized with ammonia, at the sulfo group, which is later replaced by the polyvalent metal cation, such as Ca). The calcium salt thus obtained, as also in the result of procedure (A—6), is obtained as such merely by removal of the neutralization by-product (which in this case is water which is evaporated to obtain the salt described on page 4 hereof).

(A—8) The corresponding basic and neutralized barium and strontium salts are obtained by substituting barium oxide and strontium oxide for calcium oxide in procedures (A—6) and (A—7).

(A—9) The corresponding basic and neutralized zinc, magnesium and cadmium salts are obtained by substituting zinc oxide, magnesium oxide and cadmium oxide for calcium oxide in procedures (A—6) and (A—7); but as in the case of the less electropositive metallic oxides, it is preferable to prepare the zinc and cadmium salts from more readily soluble compounds thereof such as zinc chloride and cadmium chloride. It will be appreciated that the instant aspect of the present invention is based upon the discovery that these particular alpha-sulfo compounds will readily accept the polyvalent metallic ion and form a stable bond therewith so that a true salt may be formed, which salt (or basic salt) is thus produced in a suitable form so that it is capable of various uses mentioned herein, which are based upon the characteristics of the instant anion as well as the characteristics of the metallic cation in the particular combination. Although the compounds of the invention may be prepared in the presence of suitable inert solvents, there is the advantage that this is not necessary in most instances and the by-products such as water or hydrochloric acid formed in the final neutralization procedure are readily removed by conventional procedures.

(A—10) The uses of the aforementioned Group II metal salts of calcium, barium, strontium, zinc, magnesium and cadmium based upon the anionic detergent characteristics thereof have already been described herein, particularly in cases involving the aforesaid radical R having from 12 to 16 carbon atoms, in which case any of such compounds may be used, for example, to replace the zinc compound in hereinafter described composition (32), so as to obtain a cleansing powder. It will further be appreciated that these compounds are not limited merely to detergent uses and, instead, these compounds find uses wherein the anionic component assists in dispersing the metallic component in various media and resulting compounds of the invention are found to protect against cellulolytic molds and bacteria. The cadmium compounds are known industrial poisons for various uses and the new compounds of the co-pending application are used for these purposes advantageously because of the anionic component.

(A—11) Using beryllium chloride or oxide in place of calcium oxide in the procedures (A—6) and (A—7), one obtains the corresponding beryllium compounds, which are useful to protect against mold and bacteria.

(A—12) Using mercuric oxide, in place of the calcium oxide in procedures

(A—6) and (A—7), one obtains the basic and neutralized mercuric salts, e.g., basic and neutralized mercuric methyl alpha-sulfo myristate, which compounds are useful as bactericides and fungicides. The Group II metal salts such as the foregoing mercuric salts and comparable zinc and cadmium basic and neutralized methyl alpha-sulfo myristates are particularly useful fungicides for the reason that the anionic component thereof facilitates their dispersion in commercial compositions. The barium salts, e.g. basic and neutralized barium methyl alpha-sulfo myristate and isobutyl alpha-sulfo myristate also have utility characteristic of organic barium compounds in high temperature lubricants.

(B) *Other Polyvalent Metal Salts*

(B—1) Using in place of the calcium oxide in procedures (A—6) and (A—7) basic copper carbonate, $2 \text{CuCO}_3 \cdot \text{Cu(OH)}_2$, and using heat up to $100\text{--}120^\circ \text{C}$. to complete the reaction, one obtains the corresponding cupric basic and neutralized salts, which also have use as protective agents against molds and bacteria.

(B—2) Using the procedures (A—6) and (A—7) with the calcium oxide being replaced by corresponding molar proportions of lead oxide (litharge), one obtains the corresponding basic and neutralized lead (plumbous) compounds, which were used as industrial poisons, in antiseptic compositions, and in paints as a dryer. Such compounds as basic copper and lead methyl alpha-sulfo myristate have the uses just mentioned and the advantages that they are readily dispersed in commercial compositions for such uses.

(B—3) Using in place of the calcium oxide, in procedures (A—6) and (A—7), cobaltous acetate, cobaltic chloride, nickelous acetate, nickelic oxide, ferrous acetate or ferric acetate, one obtains the corresponding divalent or trivalent nickel, iron or cobalt salts. These compounds are generally more stable in the divalent salt form; but the nickelized cobaltous, nickelous and ferrous methyl alpha-sulfo myristate compounds are typical compounds of the invention disclosed in the co-pending application and are useful as paint dryers, and as assistance in tanning and the manufacture of dyes and pigments. The corresponding basic trivalent iron, nickel and cobalt salts are similarly useful. In the preparation of these various salts, the water-soluble by-products formed are easily removed by washing.

(B—4) Typical rare earth salts are obtained by carrying out the procedures (A—6) and (A—7), using in place of the calcium oxide, cerous sulfate, $\text{Ce}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$, or ceric ammonium nitrate, $(\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6$, and the resulting basic trivalent and tetravalent cerium salts, e.g., basic cerous or ceric methyl alpha-sulfo myristate. These compounds are useful in the textile industry, as intermediates, oxidizing agents (in the case of the ceric compounds) and as additives in antiseptic compositions. In addition, it will be noted that the foregoing cerium compounds are actually prepared from crude rare earth compositions (composed of 50% cerium, 25% lanthanum, 15% neodymium, and 10% praseodymium, terbium, yttrium and samarium), but it will be appreciated that the corresponding substantially pure individual rare earth metal compounds may be used as starting materials in this procedure, so as to obtain their counterpart salts, having the same uses.

(B—5) Using, in place of the calcium oxide, corresponding amounts of stannous chloride or stannic sulfate, in the procedures (A—6) and (A—7), one obtains the corresponding tin salts. For example, neutralized stannous and basic stannic methyl alpha-sulfo myristate are compatible with soap and detergent compositions of the invention and (possessing the typical bacteriostatic properties of tin compounds of the invention), these compounds have additional use as prospective additives in toothpaste.

(B—6) Using aluminum chloride, in place of the calcium oxide, in procedures (A—6) and (A—7) one obtains aluminum compounds, having the uses of organic aluminum compounds. For example, the basic aluminum methyl alpha-sulfo myristate salt is useful in cosmetics, as an antiperspirant. In addition, the neutralized aluminum salts are capable of forming gels (e.g. in mineral spirits or gasoline as a substitute for organic aluminum compounds used with "Napalm").

(B—7) Group V salts may be prepared from bismuth acetate or antimony (antimonous) chloride, which may be used in place of the calcium oxide in procedures (A—6) and (A—7) to obtain the corresponding bismuth and antimony salts which are useful in antiseptic compositions and have, additionally, medicinal uses typical of other organic salts of these metals. For example, basic bismuth or antimony salts of methyl alpha-sulfo myristate are found to be excellent bactericides.

(B—8) Using, in place of the calcium oxide, in the procedures of (A—6) and (A—7), such compounds as manganous acetate and chromium acetate, one obtains manganese and chromium salts useful as additives in paints and inks. For example,

basic maganous and chromium methyl alpha-sulfo myristate are compatible with paint and varnish compositions.

(B-9) It will be appreciated that each of the various salts described herein has various uses other than in the cleansing or detergent field, but these salts are particularly useful in that they are combinable with the non-ionic (a_2) herein described in the proportions set forth for use in very dilute aqueous dispersions, with or without toxicants. Also, they may be combined with the various anionic detergents described herein (ingredients (a_2), (a_1), and (a_1), as well as the specifically suggested detergents (a_1) of the invention) so as to be readily dispersed in dilute concentrations in commercial formulations adapted to their particular use. Also, they are compatible in the proportions set forth herein for use in concentrated compositions, that are packaged and shipped to the end user for ultimate dilution.

For brevity hereinafter, the basic and neutralized salts of the alpha-sulfonic acid esters and amides of the invention will referred to merely as "basic" or "neutralized" alpha-sulfo compounds (e.g. "basic" calcium N-ethylol alpha-sulfo myristamide or "neutralized" barium amyl alpha-sulfo caprate). Other compositions of the invention includes the following:

COMPOSITION (12)

5 parts of neutralized calcium methyl alpha-sulfo myristate
5 parts of neutralized calcium lauryl sulfate
10 parts of nonyl phenol (16 mol) alkoxylated with a 12 mol ethylene oxide
—4 mol propylene oxide mixture.

COMPOSITION (13)

The anionic detergent component of Composition (12) may be replaced by 10 parts of neutralized magnesium or zinc methyl, ethyl, ethylol or (tetraoxyethyl) ethylol alpha-sulfo palmitate in such toxicant emulsifiers. Likewise, such use may be made of the same proportions of neutralized calcium, magnesium or zinc N-methyl, N-ethylol, or N-(triethoxyethyl) ethylol alpha-sulfo myristamide.

COMPOSITION (14)

5 parts of neutralized magnesium methyl alpha-sulfo myristate
5 parts of sodium lauryl sulfate
5 parts N-isopropylol lauramide
Remainder aqueous-ethanol selective solvent.
This liquid formulation may be used for light duty (dishwashing, etc.) purposes or for shampoos.

The detergent compositions of the invention may also include certain chelating agents (t) of the type which possess unusual storage stability, superior to that of, for example, the inorganic phosphate type builders described herein. Whereas the phosphatate type builders (b) have a number of advantages in use and in economy, such chelating agents (t) which are now commercially available are known to possess superior stability, and these chelating agents have been found to possess properties which permit their substitution in whole or in part for the inorganic builder component herein and in the various compositions described in the parent applications on which the instant application is based. These chelating agents are available as "VERSENE" compounds, which include ethylenediamine-tetraacetic acid and its salts (particularly the alkali metal salts). ("Versene" and "Versenol" are Trade Marks).

"VERSENE 9" (A powdered form of the trisodium salt of ethylenediaminetetraacetic acid, technical).

"VERSENE 67" (A dilute, light straw-colored, aqueous solution of the tetrasodium salt of ethylenediaminetetraacetic acid, technical).

"VERSENE 100" (A concentrated, straw-colored, aqueous solution of a technical grade of tetrasodium salt of ethylenediaminetetraacetic acid).

"VERSENOL 120" (A concentrated solution of the trisodium salt of N-hydroxy-ethylethylenediaminetriacetic acid, technical).

"VERSENOL BEADS" (A spray-dried form of the trisodium salt of N-hydroxyethylthylenediaminetriacetic acid, technical).

"VERSENOL POWDER" (A powdered form of the trisodium salt of N-hydroxyethylthylenediaminetriacetic acid, technical).

5 Still other chelating agents which are used in the practice of the instant invention are available under the following trade names: 5

"HAMP-ENE" (ethylenediaminetetraacetic acid and the di-, tri- and tetra-sodium salts thereof).

10 "HAMPSHIRE NTA" (nitrioloacetic acid and the di- and tri- sodium salts thereof). 10

"HAMP-EX" (diethylene triamine pentaacetic acid pentasodium salt in approximately 40% aqueous solution).

"HAMP-OL" (hydroxyethylthylenediamine triacetic acid trisodium salt in approximately 40% aqueous solution).

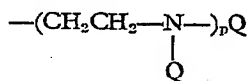
15 "HAMP-ENE EDG" (ethanol diglycine disodium salt in approximately 50% solution). 15

"HAMP-ENE DEG" (diethanol glycine sodium salt — 47% solids).

The chelating agents (t) may be represented by the following generic formula:



20 wherein T is selected from H and alkali metals, each Q is selected from $-\text{CH}_2\text{COOT}$ and (C_2-C_3) alkylol groups, and U is selected from the class consisting of Q and 20



25 groups wherein p is 1 or 2. Expressed in more general terms employed by those skilled in the art, the chelating agents (t) are aminopolycarboxylates (e.g. Drew U.S. Patent No. 3,001,945). It will be understood that such other known organic chelating agents (t) as sodium citrate (i.e. hydroxycarboxylates) may be used (and preferably are in 25 cosmetics, shampoos and the like) also as a complete replacement for inorganic alkaline builders or in aqueous-alcohol systems which cannot dissolve such builders. These organic chelating agents (t) are non-detergents in the sense that they do not contain 30 the typical long aliphatic detergent chain and, instead are essentially water-soluble organic (carboxylate) compounds having only short aliphatic chains. It will be found that these chelating agents (t) are roughly speaking about ten times more effective than, for example, the sodium tripolyphosphate or other typical members of the inorganic 35 alkaline builder class which also function as "water softeners"; so that the chelating agents (t) may be used to replace completely the various inorganic alkaline builders (b) in proportions ranging from about 5% of the amounts hereinbefore specified for the component (b) up to about 25% of such proportion specified for ingredient (b), 40 above which being less practical because of the comparatively higher expense of the chelating agents (t). The equivalent portion of active chelating agent (t) of any of the commercially available chelating agents specified hereinbefore can be used in the foregoing example to obtain very effective built type detergent formulations. In such 45 instances, the comparatively greater cost of the chelating agents (t) is compensated for by the fact that substantially less total weight of such materials is used as compared with the total weight of, for example, sodium tripolyphosphate. On the other hand, when a combined effect is desired, it will be appreciated that the chelating agents (t) may be used to replace from about 1% to about 10 or 15% of the total weight of the alkaline inorganic builders (b) and the two materials may be used in combination. In considering the economics of this system, it will be appreciated that

if an additional 5 or 10 parts of the chelating agent (t) is added, then the remainder of the sodium tripolyphosphate may be eliminated completely, or it may be replaced by less expensive inorganic alkaline builders and/or simple alkaline fillers such as sodium sulfate. Also, in such situations where the inorganic builder is to be removed or eliminated completely and replaced by the amounts of chelating agent (t) hereinbefore specified, it will be appreciated that concentrated detergent liquid systems may be employed, with or without the addition of conventional amounts of alkylol amines (c). As specific examples in the practice of the invention, it will be appreciated that in each of COMPOSITIONS (1), (3), (4), (5), (6), (7), (8), (9), (10) and (11), 2 parts of the chelating agents (t) just specified may be added to obtain desirable results, or the sodium tripolyphosphate is replaced completely by 10 parts of the tetrasodium salt of ethylene diamine tetraacetic acid or the trisodium salt of nitrilotriacetic acid, in order to obtain a composition having the superior results hereinbefore described. In this respect, also, it will be appreciated that the use of the chelating agents (t) is unique in that it does not appear to interfere with the polyvalent metal alpha-sulfo compounds, and in addition, the chelating agents (t) may be used with any of the compositions hereinbefore described as a partial or complete replacement for sodium tripolyphosphate in the manner just described. Expressed in terms of the weight ratio, the proportion of (a):(t) may range from about 100:1 to about 1:2, in the practice of the invention.

The compositions of the invention may also include conventional hydrotropes (a₇) of the general type known per se in the art and used particularly in concentrated liquid detergents for the purpose of rendering the liquid detergent homogeneous (i.e. in a function comparable to that of a solvent coupler). Such materials include the known short chain (i.e. C₁—C₃ alkyl) mono- or di-substituted benzene sulfonates, such as the alkali metal (or other salts whose cationic designation M has been explained hereinbefore of benzene, toluene, xylene, propylbenzene, etc. sulfonic acids). Such hydrotropes are used in conjunction with the detergents and are thus designated (a₇), although they are not per se ordinarily considered to be detergents; and they are used in relatively small amounts ranging from about 1% to approximately 25% of the organic detergent (a) component, i.e., the ingredients (a₁) and (a₂), with or without ingredients (a₃), (a₄) and/or (a₅).

Although the alkylol amides (c) hereinbefore described are recognized as preferred foam stabilizers of the type involving nitrogen compounds with long chain (C₁₀—C₂₀) aliphatic groups, it will be noted that the so-called "amine oxides" which are described in particular detail in Drew U.S. Patent No. 3,001,945 may also be used in the practice of the invention as partial or complete replacements for the alkylol amides (c) hereinbefore described. Such amine oxides are sufficiently described in said U.S. Patent No. 3,001,945, which disclosure is incorporated herein by reference, so that they need not be described in substantial detail herein, but it is sufficient to note that these materials are defined generically as (c₁) an amine oxide, having the formula:



wherein R₁ is one or more C₁₀ to C₁₈ alkyl radicals, at least 50% of which are C₁₂, and wherein R₂ and R₃ are each selected from the class consisting of methyl and ethyl groups. The amine oxide (c₁) is used to replace all or part of the alkylol amides (c) hereinbefore described.

It will be appreciated that another aspect of this invention involves the use as the principal component of the organic detergent (a) of (a₁) as defined herein, in combination with the chelating agents (t) in the proportions described herein and/or the nitrogen containing emulsifiers and/or foam stabilizers, designated generally by the letter (c), which include both the alkylol amides and the amine oxides (c₁), in the proportions set forth herein for the component (c). The foregoing combinations of organic components may be used in built systems with alkaline builders (b) in the proportions hereinbefore described or they may be used in concentrated liquid detergents in aqueous systems, with or without the hydrotropes described herein. The various systems involving alpha-sulfo compounds described in the aforesaid parent applications may be modified in the manner herein described.

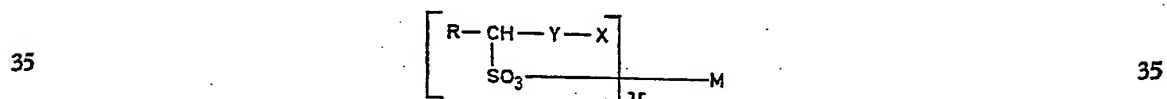
The following composite Example is representative of preferred embodiments of the invention:

COMPOSITE EXAMPLE

- (a₁) 6 parts neutralized Ca or Na alpha-sulfo methyl tallowate (in 50—50 combination or either alone)
- 5 (a₂) 3 parts sodium lauryl sulfate or (tetra)ethoxylated tallow alcohol sulfate (in 50—50 combination or either alone). 5
- (c) 2 parts dimethyl dodecyl amine oxide or lauric isopropanol amide (in 50—50 combination or either alone). Added for superior sudsing and foam stabilization.
- 10 (x) 6 parts sodium tallow and/or coconut soap; added to demonstrate excellent function of composition at economic advantage in total cost of organic detergent (a) component. 10
- 15 (b) 40 parts sodium tripolyphosphate (with or without related ortho, meta and pyrophosphates); added primarily in heavy duty detergent formulations, in combination with (a₁), optionally (a₂), (c), and (x) when preferred for economic reasons. 15
- (t) 15 parts tetrasodium ethylene diamine tetraacetate or trisodium nitriletriacetate; added as complete replacement for (b) or in ratio (b):(t) of about 5:1.
- 20 5 parts sodium disilicate, preferably added for superior maintenance of desired alkaline balance, with (b) and/or (t). 20
- 20 parts sodium sulfate (anhyd.) primarily inert generally alkaline filler; optional; but preferred in heavy duty use with (b).
- 1 part carboxymethylcellulose, an anti-redeposition agent; preferred particularly in heavy duty use.
- 25 100 parts water or aqueous-methanol selective solvent for light duty detergent liquid concentrates; preferably used in absence or substantial absence of sodium sulfate, and/or (b). 25
- 3 parts sodium toluenesulfonate hydrotrope; preferably used in liquid concentrates.
- 30 In another embodiment, a soap bar is formed comprising 50 to 95% soap and 5 to 50% (and preferably 10—25%) detergent (a) comprising primarily detergent (a₁). 30

WHAT WE CLAIM IS:—

1. A detergent composition, which comprises a water-soluble sulphonated detergent (a₁) of the formula:



wherein

- R is a C₄—C₂₀ alkyl group from a fatty acid,
- Y is C:O.O, C:O.NH or C:O.NX',
- X is H, a C₁—C₆ alkyl radical, a —CH₂CH(OH)CH₂OH, a —CH₂CH(OH)CH₂O (C₁—C₆) alkyl or a (C₂—C₄ alkyleneoxy)_n—H radical wherein n is an integer from 1 to 10, provided that X is not H when Y is C:O.O,
- X' is X or H, and
- M is a metallic ion, the ammonium radical, a C₂—C₄ alkylol ammonium radical, metal, zinc, ammonium or C₂—C₄ alkylol ammonium salt of a sulphate C_{1v}—C₂₂ alkylol/ammonium radical wherein m is an integer from 1—4, v is the valency of M; the total number of carbon atoms in R and in any C—C chain in X being 8 to 24; and a water-soluble detergent (a₂) which consists of an alkali metal, alkaline earth
- 40 40
- 45 45

metal, zinc, ammonium or C_2-C_4 alkylol ammonium salt of a sulphate $C_{10}-C_{22}$ fatty alcohol or alkoxylated $C_{10}-C_{22}$ fatty alcohol.

2. A composition according to claim 1, in which the weight ratio of the detergent (a_2) to (a_1) ranges from 1:10 to 5:1.

3. A composition according to claim 1 or 2, in which the detergent (a_2) is sodium lauryl sulphate or triethanol ammonium lauryl sulphate.

4. A composition according to claim 1, 2 or 3, which also includes a water-soluble detergent (a_3) which consists of a polyalkyleneoxy condensate of a C_6-C_{12} alkyl phenol or thiophenol.

5. A composition according to claim 4, in which the weight ratio of the detergent (a_3) to the other detergent material in the composition ranges from 1:10 to 2:1.

6. A composition according to claim 4 or 5, in which each molecule of the condensate (a_3) contains from 2 to 16 ethyleneoxy or propyleneoxy groups.

7. A composition according to claim 6, in which the detergent (a_3) is nonyl phenol ethoxylated with 9 to 10 mols of ethylene oxide, or nonyl thiophenol ethoxylated with 3 to 4 mols of ethylene oxide.

8. A composition according to any preceding claim, which also includes a water-soluble detergent (a_4) which consists of a condensate as defined in claim 4 or 6 having at the end of the alkyleneoxy chain a neutralised sulphate group of the formula $-SO_3M'$ wherein M' is an alkali metal, an alkaline earth metal, ammonium, or a C_2-C_4 alkylol ammonium group.

9. A composition according to claim 8, in which the weight ratio of the detergent (a_4) to the other detergent material in the composition ranges from 1:10 to 2:1.

10. A composition according to claim 8 or 9, in which the detergent (a_4) is sodium sulpho nonyl phenol or triethanol ammonium sulpho nonyl phenol ethoxylated with 5 mols of ethylene oxide.

11. A composition according to any preceding claim, which also includes a water-miscible detergent (a_5) which consists of an alkali metal, alkaline earth metal, ammonium or C_2-C_4 alkylol ammonium salt of a sulphonated C_6-C_{22} alkyl aryl compound, wherein the aryl group contains 1 or 2 benzene nuclei.

12. A composition according to claim 11, in which the weight ratio of the detergent (a_5) to the other detergent material in the composition ranges from 1:20 to 1:5.

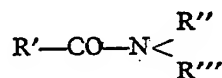
13. A composition according to claim 11 or 12, in which the detergent (a_5) is sodium dodecylbenzene sulphonate.

14. A composition according to any preceding claim, which also includes a water-soluble detergent builder (b) which is an alkaline reacting salt of a weak inorganic acid.

15. A composition according to claim 14, in which the weight ratio of the detergents (a_1-a_5) to the builder (b) ranges from 20:1 to 1:20.

16. A composition according to claim 14 or 15, in which the detergent builder (b) is selected from sodium tripolyphosphate, trisodium phosphate, sodium silicate and alkali metal carbonate.

17. A composition according to any preceding claim, which also includes an alkylolamide (c) of the formula



wherein:

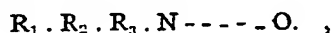
$R'-CO-$ is a $C_{10}-C_{20}$ acyl radical from a fatty acid,

R'' is H, a C_1-C_4 alkyl radical or R''' , and

R''' is selected from C_2-C_4 alkylol radicals and condensates of 2-5 mols of C_2-C_4 alkylene oxides with such alkylol groups.

18. A composition according to claim 17, in which the weight ratio of the detergents (a_1-a_5) to the alkylolamide (c) ranges from 20:1 to 1:2.

19. A composition according to claim 17 or 18, in which the alkylolamide (c) is replaced at least in part by (c_1) an amine oxide of the formula



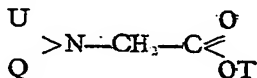
wherein:

R_1 is one or more $C_{10}-C_{16}$ alkyl radicals of which at least 50% are C_{12} , and R_2 and R_3 are methyl or ethyl radicals.

20. A composition according to any preceding claim, which also includes a water-soluble non-detergent organic carboxylate chelating agent (t).

21. A composition according to claim 20, in which the weight ratio of the detergents (a_{1-5}) to the chelating agent (t) ranges from 100:1 to 1:2.

22. A composition according to claim 20 or 21, in which the chelating agent (t) has the formula



wherein:

T is H or an alkali metal,

Q is CH_2COOT or a C_2-C_3 alkylol radical, and

U is Q or a $-(\text{CH}_2\text{CH}_2-\text{N.Q})_p\text{.Q}$ group wherein p is 1 or 2.

23. A composition according to claim 22, in which the chelating agent (t) is a sodium salt of ethylene diamine tetraacetic acid.

24. A composition according to any preceding claim, which also includes soap (x), the weight ratio of the detergents (a_{1-5}) to the soap (x) ranging from 10:1 to 1:20.

25. A composition according to claim 24, in which the weight ratio of the detergents to the soap ranges from 5:1 to 1:5.

26. A composition according to claim 24 or 25 as dependent on claim 14, 15 or 16, in which the weight ratio of (a_{1-5}) + (x) : (b) ranges from 1:1 to 1:5.

27. A composition according to any preceding claim, which includes a solvent selected from low-molecular weight hydroxyl-containing solvents, so as to form a liquid detergent solution.

28. A composition according to claim 27, in which the solvent is water.

29. A composition according to claim 27, in which the hydroxyl-containing solvent is an alkanol.

30. A composition according to claim 29, in which the solvent is a mixture of water and ethanol.

31. A composition according to claim 27, 28, 29 or 30 as dependent on claim 14, 15 or 16, in which the total concentration by weight of the detergent (a) and builder (b) in the liquid composition is 5% to 70%.

32. A composition according to claim 31 as dependent on claim 14, 15 or 16, in which the total concentration by weight of the detergent (a) and builder (b) in the liquid composition is 20%.

33. A composition according to claim 27, 28, 29 or 30 as dependent on claim 17 or 18, in which the total concentration by weight of the detergent (a) and alkylol-amide (c) in the liquid composition is 5% to 70%.

34. A composition according to claim 33, in which the total concentration of (a) and (c) is 10% to 40%, the concentration of (c) being about 10% to 20%.

35. A sulphonated detergent composition according to claim 1, substantially as hereinbefore described.

36. A detergent composition, substantially as hereinbefore described with reference to the numbered compositions.

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United States Patent [19]

Person Hei et al.

[11] Patent Number: 5,723,418

[45] Date of Patent: Mar. 3, 1998

[54] ALKYL ETHER AMINE CONVEYOR
LUBRICANTS CONTAINING CORROSION
INHIBITORS[75] Inventors: Kimberly L. Person Hei, Oakdale;
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[21] Appl. No.: 655,952

[22] Filed: May 31, 1996

[51] Int. Cl.⁶ C10M 129/26; C10M 133/04;
C10M 173/02

[52] U.S. Cl. 508/511; 508/579

[58] Field of Search 508/506, 562,
508/559, 511, 579

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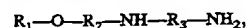
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Primary Examiner—Margaret Medley

Attorney, Agent, or Firm—Merchant, Gould, Smith, Edell, Welter & Schmidt, P.A.

[57] ABSTRACT

The invention is a lubricant concentrate composition, use solution, and method of use. The lubricant includes amine compounds of the formula,



and mixtures thereof

wherein R_1 may be a linear C_6 - C_{18} alkyl, R_2 may be a linear or branched C_1 - C_8 alkyl, and R_3 may be a linear C_1 - C_8 alkyl, and a corrosion inhibitor. The lubricant composition preferably includes a polycarboxylic acid as a corrosion inhibitor. The composition may also include a hydrotrope, stabilizer, and a surfactant to provide detergency to the composition upon dilution and use. The invention also includes a lubricant use solution resulting from dilution of this concentrate.

45 Claims, No Drawings

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ALKYL ETHER AMINE CONVEYOR LUBRICANTS CONTAINING CORROSION INHIBITORS

FIELD OF THE INVENTION

The invention relates generally to amine-based lubricant compositions and methods of use. More specifically, the invention relates to antimicrobial conveyor lubricants containing corrosion inhibitors which are based upon compositions which include linear alkyl ether amine and/or diamine compounds.

BACKGROUND OF THE INVENTION

Beverages and other comestibles are often processed and packaged on mechanized conveyor systems. These conveyor systems are lubricated to reduce friction between the packaging and the load bearing surface of the conveyor.

Antimicrobial agents are useful for conveyor systems which may transport food substances. Spillage of beverage and other comestibles on the conveyor often results in the growth of bacteria, yeast and mold and may create a slime or soil which, in turn, hampers conveyor performance and may also detract from product purity and appearance. Antimicrobial agents are particularly useful for reducing such slime formation in conveyor systems which transport food substances.

In the past, the lubricants commonly used on the load bearing surfaces of these conveyor systems typically contained fatty acid soaps as the active lubrication ingredient, and antimicrobial agents to control microbial growth. However, the tendency of fatty acid soap lubricants to react with water hardness ions compromised the overall performance of the lubricant.

Lubricant compositions which do not contain fatty acids have been developed in an effort to avoid or eliminate the precipitation problem encountered when the lubricant is diluted with water containing hardness ions. For example, Jansen, U.S. Pat. No. 4,839,067 discloses a process for the maintenance of chain-type conveyor belts by treating the conveyor belt with a lubricant composition containing a lubricating amount of a neutralized C₁₂₋₁₈ primary fatty amine. However, as noted in Jansen, the primary fatty acid amines tend to form a precipitate in the presence of anions such as SO₄⁻², PO₄⁻³ and CO₃⁻², commonly found as impurities in water which will plug spray nozzles and soil the surfaces of the conveyor system in much the same way as fatty acid soaps in the presence of water hardness.

Schmidt et al., U.S. Pat. No. 5,182,035 discloses aliphatic ether diamine acetates which are used in lubricant compositions in combination with alcoholic hydrotropes used to enhance physical stability.

Weber et al., U.S. Pat. No. 5,062,978 also discloses aqueous lubricant compositions based upon fatty alkyl amines which are useful in conveyor belt operations, especially in the transport of bottles.

Schapiro, Published European Patent Application No. 0,533,522 A1 discloses lubricant compositions comprising branched saturated or unsaturated C₆ to C₂₁ alkyl ether amines and diamines. The lubricant compositions are useful in conveyor operations and may also comprise a surfactant, and alcohol solvent.

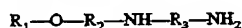
An additional precipitate problem occurs with the formation of a black precipitate which occurs during the production of certain foods. This black precipitate most often occurs during the production, processing and bottling of

carbonated beverages such as beer. In the past, this precipitate has formed to varying degrees in given applications. The precipitate is believed to result from metal on metal wear, metal corrosion, and the interaction of certain food soils, (otherwise present in the processing environment) with the lubricant used in the application.

Hence a need still exists for an antimicrobial lubricant for use on all packaging materials and conveyor surfaces, which provides improved metal on metal lubricity with corrosion inhibition properties.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the invention, there is provided a lubricant concentrate composition having an effective lubricating amount of amine compound of the formula,



and mixtures thereof

wherein R₁ may be a linear saturated or unsaturated C₆-C₁₈, R₂ may be a linear or branched C₁-C₈ alkyl, and R₃ may be a linear or branched C₁-C₈ alkyl. The concentrate contains a corrosion inhibitor and may also contain a surfactant in an amount effective to provide detergency to the concentrate upon dilution and use, and an acid in an amount effective to solubilize the amine. Optionally, the concentrate may also comprise a hydrotrope for product stability.

The invention also provides a lubricant use solution resulting from dilution of this concentrate, with the amine compound present in a concentration ranging from about 10 ppm to 10000 ppm.

In accordance with another aspect of the invention there is provided a method of lubricating a conveyor system with a use solution of the lubricant concentrate composition of the invention.

The invention is a lubricant comprised of linear alkyl ether amines and corrosion inhibitors. The linear alkyl ether amine lubricants of the invention promote lubricity and solubility in aqueous systems in the presence of ions and beverage soil, and remain in solution over a wide pH range. The lubricants of the invention remain stable and substantially unreacted with free anions and food soil present in the system. Furthermore, the linear alkyl ether amines of the invention negate the need for alcohol type solvents to maintain physical stability of the concentrate. Compositions of the invention also provide reduced metal corrosion and improved metal lubricity. The claimed invention also provides good gliding action at low dilution rates for polyethylene terephthalate (PET), glass, and metal surfaces. Further, the lubricants of the invention also provide antimicrobial efficacy on non-food contact surfaces providing a bacterial reduction of 99.9 within five minutes.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention is a lubricant concentrate composition and use solution. The concentrate may be a solid or a liquid. The compositions of the invention include linear alkyl ether amine compounds which provide lubricity, antimicrobial character, as well as a reduction in the formation of various precipitates which often occur in the environment of use. Compositions of the invention also include corrosion inhibitors, detergency agents, an acid source, and optional

hydrotropes, among other constituents. The invention also includes methods of using the claimed invention.

A. The Alkyl Ether Amine Compounds

The lubricant of the invention comprises an amine compound. The amine compound functions to enhance compositional lubricity, further antimicrobial character, and reduce or eliminate the formation of various precipitates resulting from the dilution of water and/or contaminants on the surface of application.

The amine compounds of the invention may comprise any number of species. Preferably, the amine compound is an alkyl ether amine compound of the formula,



and mixtures thereof

wherein R_1 may be a linear saturated or unsaturated C_6 - C_{18} alkyl, R_2 may be a linear or branched C_1 - C_8 alkyl, and R_3 may be a linear or branched C_1 - C_8 alkyl.

More preferably, R_1 is a linear C_{12} - C_{16} alkyl; R_2 is a C_2 - C_6 linear or branched alkyl; and R_3 is a linear or branched C_2 - C_6 alkyl.

Preferred compositions of the invention include linear alkyl ether amine compounds of formulas (1) and (2) wherein R_1 is C_{12} - C_{16} , R_2 is C_3 and R_3 is C_3 .

When the amine compound used is an amine of formula (1) and/or (2), R_1 is either a linear alkyl C_{12} - C_{16} or a mixture of linear alkyl C_{10} - C_{12} and C_{14} - C_{16} .

Overall the linear alkyl ether amine compounds used in the composition of the invention provide lower use concentrations, upon dilution, with enhanced lubricity. The amount of the amine compound in the concentrate generally ranges from about 0.1 wt-% to 90 wt-%, preferably about 0.25 wt-% to 75 wt-%, and more preferably about 0.5 wt-% to 50 wt-%.

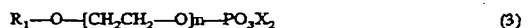
The amine materials are commercially available from Tomah Products Incorporated as PA-19, PA-1618, PA-1816, DA-1618, DA-18, DA-19, DA-1816, and the like.

The use dilution of the concentrate is preferably calculated to get disinfectant or sanitizing efficacy in the intended application of use. Accordingly, the active amine compound concentration in the composition of the invention ranges from about 10 ppm to 10000 ppm, preferably from about 20 ppm to 7500 ppm, and most preferably about 40 ppm to 5000 ppm.

B. Corrosion Inhibitors

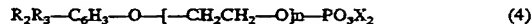
The concentrate and use dilution compositions of the invention also include a corrosion inhibitor. Useful corrosion inhibitors include polycarboxylic acids such as short chain carboxylic diacids, triacids, as well as phosphate esters and combinations thereof. Useful phosphate esters include alkyl phosphate esters, monoalkyl aryl phosphate esters, dialkyl aryl phosphate esters, trialkyl aryl phosphate esters, and mixtures thereof such as Emphos PS 236 commercially available from Witco Chemical Company.

More specifically, the esterified alkyl phosphoric acids or phosphates correspond to the general formula (3):



in which R_1 is a linear or branched saturated primary alkyl group, C_8 to C_{12} , X is hydrogen and/or an alkali metal, and n is an integer in the range from about 3 to 10.

The esterified alkyl aryl phosphoric acids or phosphates correspond to the general formula (4):



in which R_2 is linear or branched saturated primary alkyl groups, C_8 to C_{10} , R_3 is hydrogen, or linear or branched saturated primary alkyl groups, C_8 or C_{10} . X is hydrogen and/or an alkali metal, and n is an integer in the range from about 4 to about 10.

Other useful corrosion inhibitors include the triazoles, such as benzotriazole, tolyltriazole and mercaptobenzothiazole, and in combinations with phosphonates such as 1-hydroxyethylidene-1, 1-diphosphonic acid, and surfactants such as oleic acid-diethanolamide and sodium cocoamphohydroxy propyl sulfonate, and the like.

In accordance with the invention, the preferred corrosion inhibitors are polycarboxylic acids such as dicarboxylic acids. The acids which are preferred include adipic, glutaric, succinic, and mixtures thereof. The most preferred is a mixture of adipic, glutaric and succinic acid, which is a raw material sold by BASF under the name SOKALAN® DCS.

The corrosion inhibitors concentration in the composition range from 0.05% to 25% and, preferably, from 0.1% to 20%, in the concentrate. In one preferred aspect, the concentrate comprises from about 1 wt-% to 6 wt-% of corrosion inhibitor and comprises the Sokalan® DCS diacid mixture.

C. Neutralizing Agents

Generally, a neutralizing agent may also be used to provide an effective pH between about 5 and 10 in both the concentrate and use solution.

Exemplary acids include organic and inorganic acids. Inorganic acids useful in the composition of the invention include hydrochloric acid, phosphoric acid, hydrofluoric acid, sulfuric acid, nitric acid, hydrobromic acid, and sulfamic acid, among others.

Organic acids useful in the invention include acetic acid, hydroxyacetic acid, gluconic acid, lactic acid, benzoic acid, C_8 - C_{20} saturated and unsaturated fatty acids, such as oleic acid, and mixtures thereof.

The concentration of acid should be adequate and effective to solubilize and stabilize the various constituents and the concentrate and use dilution compositions of the invention.

D. Surfactants

The lubricant compositions of the invention optionally, but preferably, may further include a surfactant. The surfactant functions as an adjuvant to increase detergency and lubricity. Compounds which may be used as surfactants in the invention include, nonionic surfactants, amphoteric surfactants, anionic surfactants, and cationic surfactants, among other compounds.

Anionic surfactants are generally those compounds containing a hydrophobic hydrocarbon moiety and a negatively charged hydrophilic moiety. Typical commercially available products provide either a carboxylate, sulfonate, sulfate or phosphate group as the negatively charged hydrophilic moiety. Particularly suitable anionic surfactants for use in the lubricant composition of the invention are the phosphate esters. Broadly, any of the commercially available anionic surfactants may be usefully employed in the lubricant composition of the invention.

Nonionic surfactants are generally hydrophobic compounds which bear essentially no charge and exhibit a hydrophilic tendency due to the presence of oxygen in the molecule. Nonionic surfactants encompass a wide variety of polymeric compounds which include specifically, but not exclusively, ethoxylated alkylphenols, ethoxylated aliphatic alcohols, ethoxylated amines, ethoxylated ether amines, carboxylic esters, carboxylic amides, and polyoxyalkylene oxide block copolymers.

Particularly suitable nonionic surfactants for use in the lubricant composition of the invention are the alkoxyated (preferably ethoxylated) alcohols having the general formula $R^{10}O((CH_2)_mO)_n$ wherein R^{10} is an aliphatic group having from about 8 to about 24 carbon atoms, m is a whole number from 1 to about 5, and n is a number from 1 to about 40 which represents the average number of ethyleneoxide groups on the molecule.

Cationic surfactants are also useful in the invention and may also function as an additional antimicrobial. Typical examples include quaternary ammonium chloride surfactants such as n -alkyl (C_{12-18}) dimethyl benzyl ammonium chloride, n -alkyl (C_{14-18}) dimethyl benzyl ammonium chloride, n -tetradecyl dimethyl benzyl ammonium chloride monohydrate, n -alkyl (C_{12-14}) dimethyl 1-naphthylmethyl ammonium chloride.

Amphoteric surfactants, surfactants containing both an acidic and a basic hydrophilic group can be used in the invention. Amphoteric surfactants can contain the anionic or cationic group common in anionic or cationic surfactants and additionally can contain either hydroxyl or other hydrophilic groups that enhance surfactant properties. Such amphoteric surfactants include betaine surfactants, sulfobetaine surfactants, amphoteric imidazolinium derivatives and others.

In the concentrate, the surfactant concentration generally ranges from about 0.01 wt-% to 50 wt-%, and preferably from about 0.1 wt-% to 20 wt-%. More preferably, the surfactant concentration ranges from about 1 to 10 wt-% and the surfactant is a nonionic alcohol ethoxylate such as Neodol 25-7 from Shell Chemical.

E. Hydrotrope

The lubricant composition of the invention may optionally include an effective amount of a hydrotrope for viscosity control and cold temperature stability of the concentrate.

A variety of compatible hydrotropes are available for use in the lubricant composition including monofunctional and polyfunctional alcohols as well glycol and glycol ether compounds. Those which have been found most useful include alkyl alcohols such as, for example, ethanol, isopropanol, and the like. Polyfunctional organic alcohols include glycerol, hexylene glycol, polyethylene glycol, propylene glycol, sorbitol and the like.

The preferred hydrotropes are di-functional alcohols such as alkyl glycols. One compound which has found heightened efficacy in stabilization of the concentrate and its use solution is hexylene glycol. Generally, the concentration of the hydrotrope ranges from about 0.1 to 40 wt-%, and preferably about 1 to 25 wt-% in the concentrate. In one of the more preferred aspects of the invention, the hydrotrope is present in a concentration ranging from about 3 wt-% to 10 wt-% and comprises hexylene glycol.

WORKING EXAMPLES

The following Working Examples illustrate the various properties, characteristics, and embodiments of the inven-

tion. However, these are not intended to be limiting of the claimed invention:

EXAMPLE 1

Friction and Wear Testing

Lubricant concentrates for friction and wear testing were prepared as set forth in Table 1, by combining soft water with the hydrotrope and acid, heating to 120° F., and adding the remaining raw materials with mixing. Use solutions of these concentrates were made by combining 1000 parts tap water (5-6 grains hardness) with 2.5 parts concentrate to yield 0.25% solutions.

TABLE 1

Formulas Prepared for Friction and Wear Testing				
Raw Material	wt-%			
	1A	1B	1C	1D
C12/C14 alkoxypropyl-1,3-diamino propane	9.0	8.0	8.0	
N-octyl-1,3-diamino propane				4.0
N-coco-1,3-diamino propane				4.0
Glutaric/Adipic/Succinic Acid ¹	4.0			
Acetic Acid			1.8	1.8
Phosphate Ester ²		18.2		
Hydrotrope	7.0	10.0	10.0	10.0
Nonionic Surfactant	7.0	10.0	10.0	10.0
Soft Water	73.0	53.8	70.2	70.2

¹Diacid mixture available from BASF Corporation as Sokalan DCS.

²Emphos PS 236 phosphate ester available from Witco Chemical.

A Falex Friction and Wear Machine (Faville-LeVally Corp., Model: Pin and V-Block) fitted with mild steel v-blocks (1137) and stainless steel pins (302) was employed to determine the fail point of lubricant use solutions. The solutions were circulated over the v-block and pin assembly at a rate of 100 ml/min. Meanwhile, pressure on the falex was set to 50 psi for 5 minutes, then increased to 200, 250, 300, etc. at 5 minute intervals until such time as grossly erratic torque readings or sudden loss of pressure indicated galling of the pin and/or v-blocks and hence failure. The pressure was re-set to the desired level at one minute intervals in the event that minor loss of pressure occurred. The torque, pressure, and wear as measured by tooth adjustments, were recorded each minute.

TABLE 2

Friction and Wear Fail Point Determination					
Formula	Amine Type	Acid Source	pH	Fail Point (psi)	Elapsed Time (min:sec)
1A ¹	Linear Ether Diamines	Diacid Mixture	6.8	330	20:00
1B ¹	Linear Ether Diamines	Phosphate Ester	7.3	200	6:45
1C	Linear Ether Diamines	Acetic	7.6	190	5:00
1D	Alkyl Diamines	Acetic	7.6	200	5:30

¹Formulas represent the teaching of the current invention.

Neutralization of the linear ether amines with a combination of diacids results in a reduction in friction and wear between mild steel and stainless steel. Both commercial and experimental lubricants utilizing acetic acid neutralization fail shortly after the five minute equilibration at 50 psi.

EXAMPLE 2

Corrosion Inhibition

Lubricant concentrates were prepared as set forth in Table 3 by combining soft water with the specified acid and

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hydrotrope, warming to 120° F., and adding the remaining raw materials with mixing.

TABLE 3

Formulas Prepared for Mild Steel Corrosion Testing					
Raw Material	wt.-%				
	2A	2B	2C	2D	2E
Tetradecyloxypropyl-1,3-diamino propane	6.0	6.0	6.0		
C ₁₂ /C ₁₅ alkyloxypropyl-1,3-diamino propane				6.0	6.0
Glutaric/Adipic/Succinic Acid ¹	4.0				
Acetic Acid		2.2	1.1		
Glycolic Acid				4.0	4.0
Phosphate Ester ²			9.1		
Hydrotrope	3.0	3.0	3.0	5.0	5.0
Nonionic Surfactant	10.0	10.0	10.0	10.0	10.0
Corrosion Additive ³				5.0	
Soft Water	77.0	78.8	70.8	70.0	75.0

¹Diacid mixture available from BASF Corporation as Solkalan DCS.

²Phosphate ester Emphos PS 236 available from Witco.

³Corrosion additive referenced below.

To test mild steel corrosion inhibition for lubricant concentrates containing various neutralizing agents, 0.25% use solutions were prepared with 1000 parts tap water containing 5-6 grains hardness, and the use solution pH was adjusted to 9 with dilute KOH. Pre-cleaned 1×3 inch cold rolled steel (#1018) panels were immersed in the use solution such that the use solution covered half of the coupon. Corrosion of the panel and use solution clarity were assessed visually after 24 hours, and rated according to the description listed below. All testing was completed in duplicate. The samples were evaluated on the basis of the following scale.

Rank	Solution Appearance	Panel Corrosion
1	Solution unchanged	No visible signs of corrosion
2	Solution slightly discolored	Very slight corrosion, 1-5% of panel surface area showing corrosion.
3	Solution discolored	Moderate corrosion, 6-10% of panel surface area showing corrosion.
4	Solution is dark amber	Heavy corrosion, 11-90% of panel surface area showing corrosion.

TABLE 4

Mild Steel Corrosion Testing Results for Formulas 2A, 2B, and 2C (0.25% Solutions Adjusted to pH 9, Ranked after 24 Hours)			
Formula Constituent	Corrosion Rating With 2 Readings		
	Solution Clarity	Panel Appearance	
2A Glutaric/Adipic/Succinic	2,2	2,1	
2B Acetic	3,3	3,2	
2C Phosphate Ester/Acetic	—, —	2,3	

To test mild steel corrosion inhibition for lubricant concentrates containing various corrosion inhibitors, 0.5% use solutions were prepared from Formulas 2D and 2E. For this evaluation the solutions were prepared by combining 5 parts concentrate with 1000 parts tap water containing 5-6 grains hardness, and the solution pH adjusted to 8 with dilute KOH. Pre-cleaned 1×3 cold rolled steel (#1018) panels were

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immersed in the use solution such that the use solution covered half of the coupon. Corrosion of the panel and use solution clarity were assessed visually after 48 hours, and rated. All testing was completed in duplicate.

TABLE 5

Mild Steel Corrosion Testing Results for Formulas 2D and 2E (0.50% Solutions Adjusted to pH 8, Ranked after 48 Hours)			
Formula	Corrosion Additive	Corrosion Rating with 2 Readings	
		Solution Clarity	Panel Appearance
2D	Adipic Acid	1,1	2,2
2D	D-isoascorbic Acid	2,2	1,2
2D	Lactic Acid	3,3	1,1
2D	Malic Acid	2,2	1,2
2D	Oleic acid diethanolamide ¹	3,3	1,1
2D	Sodium cocoamphophydroxy propyl sulfonate ²	3,3	1,1
2E	none	3,3	2,2

¹Alkanide WRS-166 sold by Rhone Poulenc

²Miranol CS sold by Rhone Poulenc.

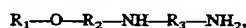
Various corrosion inhibitors and especially the diacids provide corrosion protection against mild steel in the linear alkyl ether amine formulations. Further, it is evident that the acidic species can be incorporated for the dual role of corrosion inhibitor and amine neutralizing agent, with a benefit to production cost and efficiency.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

The invention claimed is:

1. A lubricant concentrate composition comprising:

a. an effective lubricating amount of one or more amine compounds each of said amine compounds having a formula selected from the group consisting of,



and mixtures thereof wherein R₁ is a linear saturated or unsaturated C₆-C₁₈ alkyl, R₂ is a linear or branched C₁-C₈ alkylene, and R₃ is a linear or branched C₁-C₈ alkylene;

b. an anticorrosive effective amount of a corrosion inhibitor, said corrosion inhibitor comprising a dicarboxylic acid, a tricarboxylic acid or mixture thereof; and

c. a deterative amount of surfactant effective to provide detergency to the composition, said surfactant selected from the group consisting of an anionic surfactant, a nonionic surfactant, a cationic surfactant, an amphoteric surfactant, and mixtures thereof

wherein said concentrate has a pH ranging from about 5 to 10 and can be diluted to produce a lubricant having a pH greater than 7.

2. The concentrate of claim 1, wherein said amine compound is present in a concentration of about from 0.1 wt-% to 90 wt-%.

3. The concentrate of claim 1, wherein said amine compound is a monoamine compound and R₁ is a linear C₁₂-C₁₆ alkyl group, and R₂ is a C₂-C₆ alkylene group.

4. The concentrate of claim 1, wherein more than one amine compound is present in said concentrate, at least one of said amine compounds is a monoamine compound, R_1 is selected from the group consisting of a C_{10} - C_{12} alkyl group, a C_{14} - C_{16} alkyl group, and mixtures thereof; and R_2 is a C_2 - C_6 alkylene group.

5. The concentrate of claim 1, wherein said amine compound is a diamine compound, R_1 is a C_{12} - C_{16} alkyl group, R_2 is a C_2 - C_6 alkylene group, and R_3 is a C_2 - C_6 alkylene group.

6. The concentrate of claim 1, wherein more than one amine compound is present in said concentrate, at least one of said amine compounds is a diamine compound, R_1 is selected from the group consisting of a C_{10} - C_{12} alkyl group, a C_{14} - C_{16} alkyl group, and mixtures thereof; R_2 is a C_2 - C_6 alkylene group and R_3 is a C_2 - C_6 alkyl group.

7. The concentrate of claim 1, additionally comprises a hydrotrope.

8. The concentrate of claim 7, wherein said hydrotrope is selected from the group consisting of glycols, alcohols, glycol ethers, and mixtures thereof.

9. The concentrate of claim 7, wherein said hydrotrope comprises hexylene glycol, present in a concentration of from about 0.1 wt-% to 40 wt-%.

10. The concentrate of claim 1, wherein said corrosion inhibitor comprises a dicarboxylic acid present in a concentration of from about 0.05 wt-% to 25 wt-%.

11. The concentrate of claim 10, wherein said dicarboxylic acid is selected from the group consisting of glutaric acid, adipic acid, succinic acid and mixtures thereof.

12. The concentrate of claim 1, wherein said surfactant comprises a nonionic surfactant present in a concentration of from about 0.01 wt-% to 50 wt-%.

13. The concentrate of claim 12, wherein said nonionic surfactant has from about 1 to 40 moles of ethoxylation.

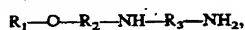
14. The concentrate of claim 1, wherein said concentrate is a solid.

15. The concentrate of claim 1, wherein said concentrate is a liquid.

16. The concentrate of claim 1, additionally comprising a neutralizing agent, wherein said neutralizing agent comprises an acid, said acid selected from the group consisting of an organic acid, an inorganic acid, and mixtures thereof.

17. The concentrate of claim 1, wherein said concentrate has a sanitizing level of antimicrobial efficacy.

18. An aqueous lubricant comprising a major portion of an aqueous diluent, from about 10 ppm to 10000 ppm of at least one amine compound, having a formula selected from the group consisting of



and mixtures thereof wherein R_1 is a linear saturated or unsaturated C_6 - C_{18} alkyl, R_2 is a linear or branched C_1 - C_8 alkylene, and R_3 is a linear or branched C_1 - C_8 alkylene; an anticorrosive effective amount of a corrosion inhibitor, said corrosion inhibitor comprising a dicarboxylic acid, a tricarboxylic acid or mixture thereof; a detergent amount of surfactant effective to provide detergency upon use, wherein said surfactant is selected from the group consisting of an anionic surfactant, a nonionic surfactant, a cationic surfactant, an amphoteric surfactant, and mixtures thereof, wherein said lubricant has a pH of from about 7 to 10.

19. The lubricant of claim 18, wherein said amine compound is present in a concentration of about 40 ppm to 5000 ppm.

20. The lubricant of claim 18, wherein said amine compound is a monoamine compound, R_1 is a linear C_{12} - C_{16} alkyl group, and R_2 is a C_2 - C_6 alkylene group.

21. The lubricant of claim 18, wherein more than one amine compound is present in said lubricant, at least one of said amine compounds is a monoamine compound, R_1 is a C_{12} - C_{16} alkyl group and R_2 is a C_2 - C_6 alkylene group.

22. The lubricant of claim 18, wherein said amine compound is a diamine compound, R_1 is a C_{12} - C_{16} alkyl group, R_2 is a C_2 - C_6 alkylene group, and R_3 is a C_2 - C_6 alkylene group.

23. The lubricant of claim 18, wherein more than one amine compound is present in said lubricant, at least one of said amine compounds is a diamine compound, R_1 is selected from the group consisting of a C_{10} - C_{12} alkyl group, a C_{14} - C_{16} alkyl group, and mixtures thereof; R_2 is a C_2 - C_6 alkylene group; and R_3 is a C_2 - C_6 alkylene group.

24. The lubricant of claim 18, additionally comprises a hydrotrope.

25. The lubricant of claim 24, wherein said hydrotrope is selected from the group consisting of glycols, alcohols, glycol ethers, and mixtures thereof.

26. The lubricant of claim 24, wherein said hydrotrope comprises hexylene glycol, present in a concentration of from about 0.001 wt-% to 1 wt-%.

27. The lubricant of claim 18, wherein said corrosion inhibitor comprises a dicarboxylic acid present in a concentration of from about 1 ppm to 10000 ppm.

28. The composition of claim 24, wherein said dicarboxylic acid is selected from the group consisting of glutaric acid, adipic acid, succinic acid and mixtures thereof.

29. The lubricant of claim 18, wherein said surfactant comprises a nonionic surfactant present in a concentration of from about 0.0005 wt-% to 1 wt-%.

30. The lubricant of claim 29, wherein said nonionic surfactant has from about 1 to 40 moles of ethoxylation.

31. The lubricant of claim 18, additionally comprising a neutralizing agent.

32. The lubricant of claim 18, wherein said concentrate has a sanitizing level of antimicrobial efficacy.

33. A method of lubricating a conveyor system using a diluted lubricant concentrate composition comprising an effective lubricating amount of one or more amine compounds, each of said amine compounds having a formula selected from the group consisting of,



and mixtures thereof wherein R_1 is a linear saturated or unsaturated C_6 - C_{18} alkyl, R_2 is a linear or branched C_1 - C_8 alkylene, and R_3 is a linear or branched C_1 - C_8 alkylene; an anticorrosive effective amount of a corrosion inhibitor, said corrosion inhibitor comprising a dicarboxylic acid, a tricarboxylic acid or mixture thereof; a detergent amount of surfactant effective to provide detergency upon dilution and use said surfactant selected from the group consisting of an anionic surfactant, a cationic surfactant, a nonionic surfactant, an amphoteric surfactant, and mixtures thereof; and wherein the said composition has a pH of from about 7 to 10, said method comprising the steps of:

a. formulating the lubricant concentrate composition to have from about 0.1 wt-% to 90 wt-% of said amine compound;

b. diluting said lubricant concentrate composition with a major portion of an aqueous diluent to form a diluted lubricant concentrate composition; and

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c. applying said diluted lubricant concentrate composition to the intended surface of use.

34. The method of claim 33, wherein said amine compound is a monoamine compound, R_1 is a linear C_{12} - C_{16} alkyl group, and R_2 is a C_2 - C_6 alkylene group.

35. The method of claim 33, wherein more than one amine compound is present in said lubricant, and least one of said amine compound is a monoamine compound, R_1 is selected from the group consisting of a C_{10} - C_{12} alkyl group, a C_{14} - C_{16} alkyl group, and mixtures thereof; and R_2 is a C_2 - C_6 alkylene group.

36. The method of claim 33, wherein said amine compound is a diamine compound, R_1 is a C_{12} - C_{16} alkyl group, R_2 is a C_2 - C_6 alkylene group, and R_3 is a C_2 - C_6 alkylene group.

37. The method of claim 33, wherein more than one amine compound is present in said lubricant, at least one of said amine compound is a diamine compound, R_1 is selected from the group consisting of a C_{10} - C_{12} alkyl group, a C_{14} - C_{16} alkyl group, and mixtures thereof; R_2 is a C_2 - C_6 alkylene group, and R_3 is a C_2 - C_6 alkylene group.

38. The method of claim 33, wherein said use solution is formulated to additionally comprise a hydrotrope.

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39. The method of claim 38, wherein said hydrotrope is selected from the group consisting of glycols, alcohols, glycol ethers, and mixtures thereof.

40. The method of claim 38, wherein said hydrotrope comprises hexylene glycol, present in a concentration of from about 0.1 wt-% to 40 wt-%.

41. The method of claim 33, wherein said corrosion inhibitor comprises a dicarboxylic acid present in a concentration of from about 0.05 wt-% to 25 wt-%.

42. The method of claim 41, wherein said dicarboxylic acids are selected from the group consisting of glutaric acid, adipic acid, succinic acid and mixtures thereof.

43. The method of claim 33, wherein said surfactant comprises a nonionic surfactant present in a concentration of from about 0.01 wt-% to 50 wt-%.

44. The method of claim 33, wherein said lubricant provides a sanitizing level of antimicrobial efficacy to the intended surface of use.

45. The method of claim 33, wherein said lubricant use solution is compatible with polyethylene terephthalate.

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